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Contents.

	PAGE
Forthcoming Events	383
As Others See Us	383
Distorted Truth in Advertising	383
Middlesbrough Presentation of I.B.F Diploma	384
Awards to Junior Foundrymen	384
I.B.F. Branch-Presidents	384
Random Shots	384
Oil-Hardening and Air-Hardening Cast Iron	385
Machinery Allowance on Castings	387
The Use of Welding in Repair Work	390
European Copper "Famine"!	390
International Commercial Arbitration	390
Machine Moulding in a Jobbing Shop	391
Foundry Problems	393
American Developments in Mechanical Cupola Charging	394
Foundrymen Visit Coventry Works	396
The A.W. Semi-Rotary Open-Flame Furnace	396
Yorkshire Foundrymen Visit Brighouse Works	396
Trade Talk	397
Personal	397
Obituary	397
Iron and Steel Markets	398
Publication Received	398

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

DECEMBER 9.

Sheffield Metallurgical Association:—Ordinary meeting. "Machining from a Machinist's Point of View," Paper by Walter Locke.

DECEMBER 11.

Institution of Welding Engineers:—Ordinary meeting in London. Paper on "The Fabrication of Plant in Acid-Resisting Steels," by C. C. Hall.

Institute of British Foundrymen.

DECEMBER 6

West Riding of Yorkshire Branch:—Ordinary meeting at Bradford. "Some Aspects of Modern Foundry Practice," Paper by F. Griffiths.

DECEMBER 9.

Lancashire Branch (Burnley Section):—Ordinary meeting at Burnley. "Survey in the Making of Light Castings," Paper by F. Harris.

DECEMBER 10.

Sheffield and District Branch:—Ordinary meeting at Sheffield. "X-ray Examination of Castings," Paper by V. E. Pullin, O.B.E., D.Sc.

DECEMBER 11.

London Branch:—Ordinary meeting in London. "Magnesium Alloy Castings," Paper by E. Player.

Birmingham, Coventry, and West Midlands Branch:—Ordinary meeting. "The Preparation and Handling of Moulding Sand," Paper by W. E. Box.

DECEMBER 12.

Middlesbrough Branch:—Ordinary meeting. "Foundry Practice Abroad: Some Personal Reflections," Paper by J. G. Pearce.

As Others See Us.

There are many respects in which the people of Great Britain know more (because they care more) about what is happening to other countries than the people of other countries know about us. Our world-wide trade and fondness for travel has made us internationally-minded, in spite of the insularity which comes from an island situation. It is refreshing, therefore, to see other countries taking a very intelligent interest in our problems and understanding their causes and remedies. Germany in particular has done so, and several books have been published lately on England and the English, and they have endeavoured to probe our attitude to sport and our institutions, such as public schools, which is all a laudable endeavour to find if there is any good in these things for them. The German craze for sport and outdoor life is said to be due to their idea that during the war the British troops showed more stamina and resistance than the German, and this was attributed to our fondness for sport. A chemist now says that it is simply due to the fact that the army rations contained not merely proper calorific value but vitamins, and, for all their science, it is said that the Germans had the former but not the latter, and were thus more prone to weakening diseases.

The German conclusion about British unemployment is that no revival of world trade can reduce British unemployment below the "refractory million," which for the last few years has always been with us, and which the depression has increased by another million. The reason they give is significant. British wages, taxes and public expenditure are too high, based on the monetary conditions for the first few years of the war. We are described as a country with inflationist wages and production cost, but without the trade-balance advantages of inflation. The wages paid here are excessively high, they say, and hence employment is impossible. We have to remember that German exports are and have been maintained through the recent depression. They also point out that when prices are falling the incidence of tariffs gets greater, and this operates against exports affected by tariffs. The Germans believe that, subject to fluctuations due to trade revivals, prices will go on falling for ten years.

They also appreciate that import duties are a corrective of the high wages. It is difficult to lower wages, but if tariffs increase prices this is equivalent to the same thing. It is unfortunate that in our present extremity there is such little appreciation of the fact that, by increase in output, high wages could be maintained and even increased, and yet production cost would fall. Except in quarters directly concerned there is practically no opposition in Germany to the principle of wage reduction, even from quarters notoriously sympathetic to the social view of labour questions. The German unemployed total is estimated at four millions.

A most interesting feature of the recently published employment proposals of Mr. Lloyd George is the idea of establishing an institution for the encouragement of invention and science in industry on the lines of the Mellon Institute in Pittsburgh. This suggestion seems to us to be based on a misunderstanding of the precise functions of that institution, and we hope to return to this point at a later date. All parties, however, appear at last to have come to realise the vital importance of research as a factor in industrial revival.

Distorted Truth in Advertising.

We have been asked by one of the largest steel foundries in Great Britain for our views as to whether the utilisation of correct but distorted scientific data in publicity matter is ethical. By distorted, we mean the reproduction of curves and photomicrographs which have been generously scaled in the former case or over-reduced on reproduction in the latter. Usually, the use of any scientific data does impress the buyer, and any bluff contained therein carries weight in inverse ratio to the buyers' technical knowledge; in fact, to the more highly-trained scientific people it may be distasteful.

We are familiar with the publicity matter sent out by our questioners and are convinced that it is of higher standard than the type now under consideration, but we must confess that for getting the momentary attention of the less-informed buyer it probably is not so forceful as the one which they enclosed as a sample of foreign manufacturers' methods. Thus, we are faced with the solving of a problem which, basically postulated, asks whether in high-grade publicity matter one should refrain from using matter which may exploit the ignorant or meet the

foreign competition cited by emulating a method chosen by some. After due consideration, we favour the emulation of the foreign competitor *in this case* on the following grounds. The foundry in question is certainly in a position, from its vast accumulated experience, its research facilities and its international reputation, to give a material equal to anything made anywhere in the world, and exaggeration from the scientific aspect would be difficult, whilst the orientation of curves would be easy. The overcoming of foreign competition by using foreign methods creates home employment, which is a moral duty of every British employer and outweighs the poor ethical standard to be associated with what we have chosen to call distortion—but still the truth.

Middlesbrough Presentation of I.B.F. Diploma.

An interesting ceremony was performed at the last meeting of the Middlesbrough Branch of the Institute of British Foundrymen, when Mr. W. Shaw, the Branch-President, presented to Mr. D. K. Barclay, of Middlesbrough, the diploma awarded him by the Institute for his Paper on "Electric Steel Founding," which was read before the Middlesbrough Branch last March.

Mr. Shaw said it was a pleasing duty for him to perform. Diplomas such as the Institute awarded were degrees to be treasured, and it was an honour for the Branch that one of its members had won the distinction. Anyone who was interested in steel founding and had read Mr. Barclay's Paper realised what a fine piece of work it was. He had entered into the most minute detail and had incorporated much informative data in an interesting manner.

The members present, including the Institute President (Mr. F. P. Wilson, J.P.), heartily endorsed Mr. Shaw's sentiments, and when Mr. Barclay was handed the diploma he was given enthusiastic applause.

Mr. Barclay, in reply, said he was greatly honoured by the award. He had to thank his colleagues at the works for the help they had given him.

The lecture during the evening was given by Mr. F. Hudson, of West Bromwich, who dealt with "What Happens to the Metal inside a Cupola." This Paper has previously been printed in our columns.

Awards to Junior Foundrymen.

At a meeting of the Junior Branch of the Lancashire Section of the Institute of British Foundrymen held last Saturday at the Manchester College of Technology, Mr. H. V. Grundy presiding, a number of awards were presented as a result of the recent examinations. Mr. B. Haigh was the recipient of the "John Wilkinson" medal, Mr. E. Sutcliffe being second. This medal has been made possible by an endowment created by Mr. Thewlis Johnson, of Messrs. Richard Johnson & Nephew. The award was supplemented by book prizes, the gift of the chairman. Another prizewinner was Mr. G. Platt, who won a book prize donated by Mr. W. Jolley in connection with a short Paper competition.

The lecturer for the evening was Mr. F. W. Rowe, B.Sc., of Huddersfield, who took for his subject "The Art of Bronze Foundry Practice." Mr. Rowe in turn touched upon the relative demand, melting practice, furnace types, running costs, types of alloys, casting temperature and physical characteristics. The discussion, which was extremely animated, extended the scope of the Paper to such subjects as cleaning and centrifugal casting. The lecturer was accorded a vote of thanks on the proposition of the new-elected vice-chairman, Mr. Kent, and seconded by Mr. Sutcliffe

I.B.F. Branch-Presidents.

No. 3.—LONDON BRANCH.

Mr. A. F. Gibbs was born at Wickham Market, Suffolk, and, after being educated at Derby, served his apprenticeship to moulding in the iron foundry attached to the Stratford Works of the Great Eastern Railway Company. At the age of 21 he left and joined Messrs. J. Kirkaldy, Limited, of Burnt Mill, Essex, where for the next twelve months he gained his first experience of non-ferrous foundry practice.

After a short interval, during which Mr. Gibbs was engaged in various London jobbing shops, he entered the service of Messrs. Richard Garrett & Sons, Limited, of Leiston, Suffolk. Four years were spent in the brass foundry and four years in the iron foundry, working on cylinders. Subsequently he returned to the Stratford Works, where his apprenticeship had been served.

He joined the G.E.R. Mechanics' Institute, and successfully passed examinations in various

Mr. A. F. Gibbs.

engineering subjects, and later gained an honours pass in the metallurgy of iron and steel. In 1913 he obtained the premier prize for research work at the Sir John Cass Technical Institute; his success he gratefully attributes to the help given him by Mr. Patchin, Principal of the Institute, Professor Bannister, Mr. Wesley Lambert, Dr. Couldron Smith and Mr. Boote. During the war he superintended the manufacture of cast copper shell bands, fuse sticks and hydraulic pipes.

In 1920 Mr. Gibbs became instructor of the foundry classes conducted at the West Ham Technical Institute, and a year later was transferred to the Sir John Cass Institute as lecturer and instructor in foundry practice. At the same time he became foundry instructor at the Borough Road Polytechnic and at the Rochester Technical Institute, but these latter classes were subsequently discontinued owing to lack of students.

At the conclusion of the war Mr. Gibbs was appointed assistant foreman of the iron foundry at Stratford, and in 1924 was made chief foreman of the brass foundry. He joined the London Branch of the Institute of British Foundrymen in 1922, and since that time has taken a keen interest in the activities of the Junior Section of the Branch.

Random Shots.

I mentioned recently the envy of France of the personality of the Prince of Wales, but this appears to be shared by other countries. After it was announced that the Prince of Wales would open the British Exhibition at Buenos Aires, America has suggested sending Colonel Lindburgh as a representative of that country to act presumably as a sort of counterblast.

* * *

Lindburgh has the advantage of having accomplished an amazing feat which had world-wide publicity, but anybody who has seen him in the film news would agree that, in spite of his charm of manner, ready smile and natural modesty, he really is rather too modest to be in a sort of permanent spotlight. As I said before, you cannot have the advantages at the same time of a limited monarchy and a republic.

* * *

If we are to develop informal ambassadors of this kind, we have no doubt that France would choose the engaging personality of M. Maurice Chevalier, who is to cash in at the rate of £4,000 a week for a couple of weeks in London. Can we really be approaching bankruptcy if we can furnish a theatre manager with such a sum to pay an artiste plus anything extra he may make on the deal?

* * *

The figures periodically given us by Sir Josiah Stamp are always interesting and invariably reliable. He recently told the Royal Statistical Society that in the six years following 1914 we spent the whole of our natural savings for those years and lost a quarter of our foreign investments. That is a most striking way of putting the cost of the great war.

* * *

For the next eight years we had saved about four hundred and fifty millions each year. He estimates the gross national capital at nearly twenty-five thousand millions. Such figures are more readily grasped in words than in figures, accompanied as they are by noughts running into astronomical magnitudes. The net capital figure he estimates at eighteen thousand millions.

* * *

His estimate of the national capital in 1914 was fourteen thousand millions, and every estimate of this since prepared has been based on it. The figures suggest that the nation is in much the same position as the individuals who comprise it. It would not be surprising, for instance, to find that an average citizen, by means of insurances and so forth, has a capital roughly equal to forty or fifty times what he can save annually. It is surprising that the nation as a whole is not more favourably placed.

* * *

A negro was brought before a judge for leaving his wife without visible means of support. The judge dilated on the evils of desertion, and was rubbing in the punishment to which he was liable as a deserter when the prisoner broke in, earnestly: "Judge, judge, I'se no deserter, I'se a refugee."

* * *

Another man was being tried for bigamy, and after a protracted hearing his guilt could not be established. The judge thereon told him that he was free to leave the court, and advised him in a friendly way to go home and be more careful in future. "Yes, judge," said the man, "I will, but I would like to be sure of being right about this. Which home shall I go to?"

Marksman.

Oil-Hardening and Air-Hardening Cast Iron.*

By J. E. Hurst.

It has become more widely known that cast iron can be manufactured suitable for heat-treatment by hardening and tempering. As the properties developed by heat-treating suitable compositions of cast iron become more widely known, it is to be anticipated that the use of such irons will extend rapidly. Already heat-treated alloy cast irons are finding a use in the manufacture of liners and cylinders for internal-combustion engines in an endeavour to provide for the more exacting wear conditions which prevail under heavy-duty conditions.

The investigations described below are some of those undertaken with the object of studying the properties of alloy cast irons of the nickel-chromium type after hardening and tempering. The particular object of the experiments was to ascertain whether or not the strength properties of the cast irons were impaired by reason of the hardening and tempering treatment.

Preparation and Treatment of the Specimens.

All the castings used for the preparation of the specimens were cast by the centrifugal process in the form of annular cylinders approximately 4½ in. dia. by 10 mm. radial thickness, by 9 in. length. The castings made by the centrifugal process are produced from metal moulds operating under controlled conditions of mould temperature. For this reason the material is exceptionally close grained and of uniform structural characteristics. To secure the maximum strength properties, the castings were made from refined iron containing the requisite amount of chromium and of guaranteed uniformity in composition. The refined iron was melted in the cupola furnace, and the requisite amount of nickel added to the metal in the ladle either in the form of scrap nickel sheet or nickel "F" shot. Nickel sheet has been found preperable to the "F" shot, as considerable difficulty has been met with in obtaining complete solution of the nickel added in shot form. This difficulty is amply demonstrated by the illustration in Fig. 1, showing the undissolved shot in a sample taken from a casting. When it is realised that the metal receives a thorough agitation during casting by the centrifugal process it will be appreciated that the difficulty of obtaining complete solution is a perfectly real one.

The castings selected for examination were cut up into specimens in the form of annular rings. For the hardness determinations, annular rings were used, having a thickness equal to the full radial thickness of the castings, and a breadth or width of approximately half an inch. For the mechanical tests, completely-machined rings were used, complying with the conditions and dimensional relationships laid down in the B.E.S.A. specification for aircraft material (*piston rings*) 4.K.6. These annular rings from specimens were hardened either by cooling in oil or air blast, after having been heated to the required temperature. The heating for hardening was carried out in a silica muffle maintained at the required temperature by gas burners. The temperature of each batch of samples hardened was controlled by a Cambridge platinum—platinum-rhodium thermo-couple pyrometer. The tempering operation of separate batches of hardened rings was effected by holding them at the required temperatures for 10 to 15 mins. in a Brayshaw salt-bath furnace. The temperatures during tempering were measured by means of a mercury thermometer. The chemical analyses of the various samples were made on cuttings taken from the castings during parting off into annular rings.

Methods of Testing.

Brinell hardness determinations were made on the thick annular ring specimens both before and after heat-treatment. The determinations were made at points approximately in the centre of the radial thickness of the specimens and in a direction parallel to the length or axis of the annular rings. The standard Jackman machine, with a 10-mm. ball under a load of 2,000 kgs., was used for the tests.

Tensile tests and determinations of the modulus of elasticity or En value were made on the machined rings by the methods laid down in the B.E.S.A. specification previously mentioned, with slight modifications. The slight modifications were necessitated by reason of the difficulty of cutting gaps in the hardened specimens. To overcome this difficulty the rings were slit at one point and the En value determined from the load required to open the rings to the gap-radial thickness relationship specified, using the formula laid down in the specification. Similar rings were used for the determination of what the author prefers to call stress/deflection curves. The data for the determination of these curves are obtained by stressing the rings slit at one point by a load applied at opposite ends of the diameter at right angles to the slit or gap. The gap openings with increasing loads are measured up to the breaking load. From these values the increment in gap opening and the stress in tons per sq. in. can be determined; this latter by use of the relationship given in the B.E.S.A. specification before mentioned. The increment in gap opening plotted against the stress in tons per sq. in. provides the stress/deflection diagram. It is necessary to add that the author is fully aware that these diagrams cannot be regarded as true stress/strain curves by reason of the method of obtaining the stress values and the utilisation of the gap opening as a measure of the strain. The justification for their use in commercial testing lies in the fact that the specimens can be prepared and the measurements made with considerable accuracy. Interpreted in a comparative manner, the stress/deflection

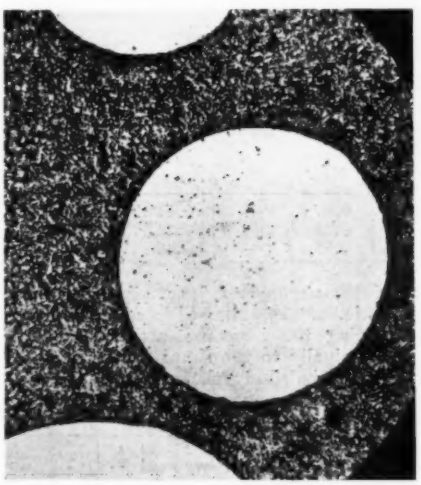


FIG. 1.—SECTION FROM CASTING SHOWING TYPICAL INCLUSION OF NICKEL "F" SHOT. ETCHED PICRIC ACID. × 25 DIAS.

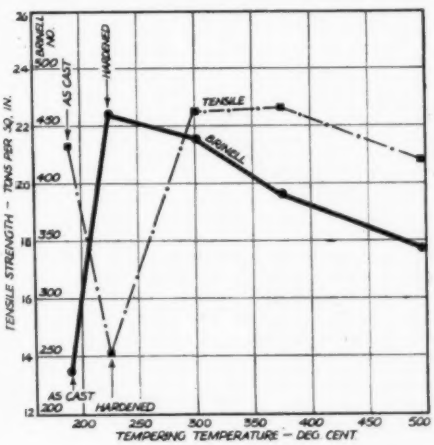


FIG. 2.—SHOWING BRINELL HARDNESS AND TENSILE STRENGTH RESULTS OF NICKEL-CHROMIUM CAST IRON (NI 1.32, CR 0.44 PER CENT.), OIL-HARDENED FROM 850 TO 875 DEG. C.

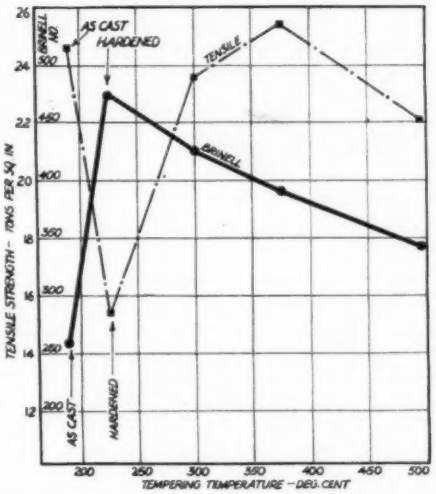


FIG. 3.—SHOWING BRINELL HARDNESS AND TENSILE STRENGTH RESULTS OF NICKEL-CHROMIUM CAST IRON (NI 2.56, CR 0.95 PER CENT.), OIL-HARDENED FROM 850 TO 875 DEG. C.

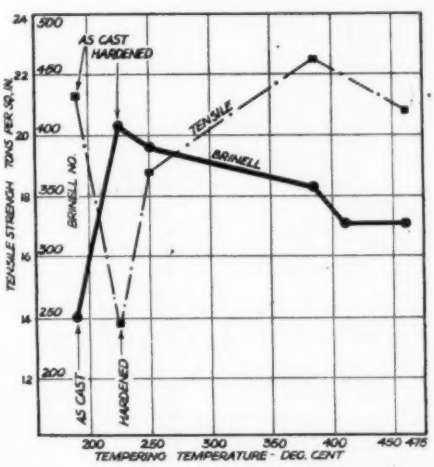


FIG. 4.—SHOWING BRINELL HARDNESS AND TENSILE STRENGTH RESULTS OF NICKEL-CHROMIUM CAST IRON (NI 3.37, CR 0.61 PER CENT.), AIR-HARDENED FROM 875 DEG. C.

* A Paper presented to the Sheffield Branch of the Institute of British Foundrymen, the Hon. J. M. W. North presiding.

diagrams provide most of the information that could be obtained from the true stress/strain curves, the preparation of which, to equivalent accuracy, for a material like cast iron, would require almost impossibly-elaborate precautions. It is also necessary to add that the stress/deflection diagrams given in this investigation are plotted from the values obtained from a second loading of the specimens, the specimens having been loaded previously to a stress value of approximately 14 tons per sq. in.

Experimental Results.

The following three cases have been selected as demonstrating the results obtained. In all cases the alloys contain nickel and chromium, and in two cases the hardening has been performed by quenching in oil, and in one case by cooling in a blast of air. The chemical composition of the three samples used in these experiments is given in Table I.

Table I.—*Composition of Samples.*

Sample.	Material.	Composition, per cent.							
		T.C.	C.C.	Si.	Mn.	S.	P.	Ni.	Cr.
G.8 ..	Oil hardening	3.36	0.69	2.30	0.67	—	0.54	1.32	0.44
G.0 ..	Oil hardening	3.35	0.65	2.07	0.61	—	0.34	2.56	0.95
G.6 ..	Air hardening	3.39	0.59	2.19	0.65	—	0.46	3.37	0.61

Test rings cut from each of the samples above mentioned were hardened and tempered at various temperatures. The results obtained are set out in Tables II to VII inclusive.

The Brinell hardness results and the tensile strength results from the above tables are represented diagrammatically in Figs. 2, 3 and 4. For the sake of clarity the En values have been omitted from these diagrams. The marked hardening effect of the hardening treatment is clearly shown, and this is accompanied by a sharp drop in tensile strength. The En values, although somewhat irregular, also show a diminished value in the hardened condition. The effect of tempering, as would be anticipated, is accompanied by a lowering of the hardness value from that attained in the hardened condition, the higher the tempering temperature the lower the hardening value. The marked influence of tempering on the tensile strength will be noticed. Tempering at low temperatures, accompanied by only a slight effect on the hardness value, immediately raises the tensile strength to approximately the original value of the material in the "as-cast" condition, and it will be noticed that this original "as-cast" value is slightly exceeded in the specimens tempered at a medium temperature.

Whilst not quite so noticeable, the diminution in the En value on hardening shows a recovery on tempering to values, in the case of G.8 sample, slightly in excess, and in the other cases to values approximately equivalent to those of the original material. The stress/deflection diagrams have been plotted for each of the specimens in these samples. In view of the fact that the indications of each set are identical, the diagrams for the one set (G.8) are included in Fig. 5.

The position of the ultimate breaking strengths on the diagrams has been obtained by continuing the curves in a smooth direction up to the value of the ultimate breaking strength. In all cases it was found possible to obtain readings of the gap opening up to within 0.75 ton per sq. in. of the ultimate breaking stress. In interpreting the diagrams attention has been paid principally to the shape of the curves and the area included by the curves. As plotted originally to a comparatively open scale, the diagrams for the "as-cast" material have a curvature up to a stress value in the neighbourhood of 14 tons per sq. in., deviating very slightly from a straight line. Above this stress value the curvature increased substantially. This type of diagram is characteristic of centri-

(*Concluded on page* 395.)

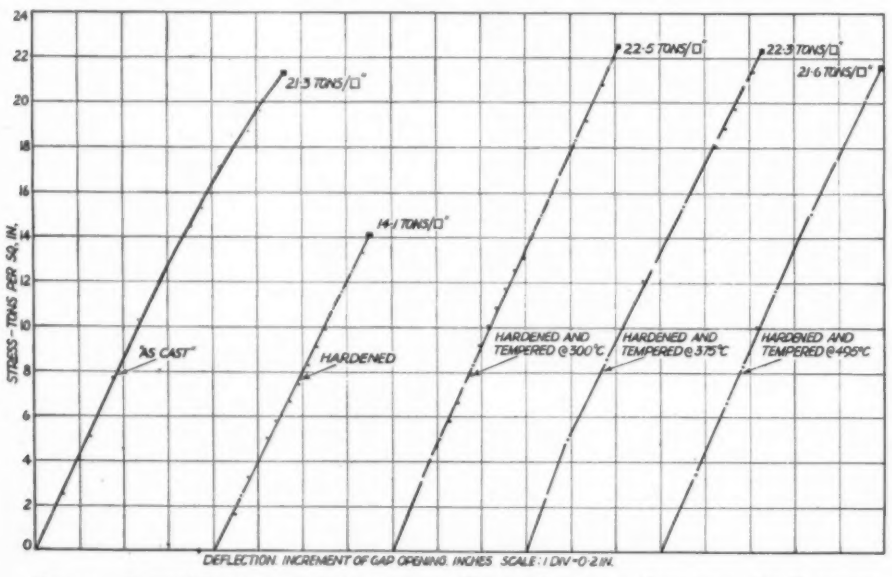


Fig. 5.—Stress/Deflection Diagrams of Nickel-Chromium Cast Iron, Oil-Hardened and Tempered.

Composition :—T.C., 3.36; C.C., 0.69; Si, 2.30; Mn, 0.67; P, 0.54; Ni, 1.32, and Cr, 0.44 per cent.

Table II.—*Brinell Hardness Tests on Oil-hardened and Tempered Material, G.8.*

Condition.	Brinell hardness.	
	Range.	Average.
"As cast"	228—242	236
Quenched in oil from 850 to 875 deg. C.	429—474	460
Tempered in salt bath at 300 deg. C.	429—450	439
Tempered in salt bath at 375 deg. C.	390—390	390
Tempered in salt bath at 495 deg. C.	342—342	342

Table III.—*Mechanical Properties of Oil-hardened and Tempered Material, G.8.*

Condition.	Elasticity (En) value.	Tensile strength.
	Lbs. per sq. in. × 10^6.	Tons per sq. in.
"As cast"	17.7	21.3
Quenched in oil from 850 to 875 deg. C.	16.2	14.1
Tempered in salt bath at 300 deg. C.	19.0	22.5
Tempered in salt bath at 375 deg. C.	17.1	22.9
Tempered in salt bath at 375 deg. C.	18.5	22.3
Tempered in salt bath at 495 deg. C.	18.2	21.6
Tempered in salt bath at 495 deg. C.	17.8	20.0

Table IV.—*Brinell Hardness of Oil-hardened and Tempered Material, G.0.*

Condition.	Brinell hardness.	
	Range.	Average.
"As cast"	242—268	259
Quenched in oil from 850 to 875 deg. C.	478—474	474
Tempered in salt bath at 300 deg. C.	400—450	425
Tempered in salt bath at 375 deg. C.	390—390	390
Tempered in salt bath at 495 deg. C.	342—342	342

Table V.—*Mechanical Strength Properties of Oil-hardened and Tempered Material, G.0.*

Condition.	Elasticity (En) value.	Tensile strength.
	Lbs. per sq. in. × 10^6.	Tons per sq. in.
"As cast"	16.0	24.6
Quenched in oil from 850 to 875 deg. C.	13.0	15.4
Tempered in salt bath at 300 deg. C.	15.6	23.6
Tempered in salt bath at 375 deg. C.	16.4	25.4
Tempered in salt bath at 495 deg. C.	15.8	22.1

Table VI.—*Brinell Hardness of Air-hardened and Tempered Material, G.6.*

Condition.	Brinel hardness.	
	Range.	Average.
"As cast"	242—276	250
Air hardened from 875 deg. C.	390—429	407
Tempered in salt bath at 250 deg. C.	390—390	390
Tempered in salt bath at 385 deg. C.	357—357	357
Tempered in salt bath at 410 deg. C.	327—327	327
Tempered in salt bath at 460 deg. C.	327—327	327

Table VII.—*Mechanical Strength Properties of Air-hardened and Tempered Material, G.6.*

Condition.	Elasticity (En) value.	Tensile strength.
	Lbs. per sq. in. × 10^6.	Tons per sq. in.
"As cast"	17.8	21.3
Air hardened from 875 deg. C.	17.7	13.85
Tempered in salt bath at 250 deg. C.	16.1	18.8
Tempered in salt bath at 385 deg. C.	16.9	22.5
Tempered in salt bath at 460 deg. C.	17.25	20.8

Machining Allowance on Castings.*

By S. W. Wise.

The local foundrymen appreciate very much indeed the privilege accorded them of attending one of the meetings of the Keighley Association of Engineers, and to have the opportunity of jointly discussing some of the conditions under which they, as founders, have to work. Such an opportunity rarely falls to their lot, as only too frequently the sole chance they have of explaining to engineers some of their difficulties is when a casting, whilst passing through their hands, calls for comment.

It is often felt that the people who handle castings after the foundry has done its best do not think of, or fully realise, the many varying factors associated with the art of founding, as, possibly, on the other hand, the founders are ignorant of the many pitfalls that have to be met with during the various machining processes. A frank discussion of mutual interests under the favourable conditions now obtaining should lead to a closer feeling of unity between two great branches of the engineering industry, with fruitful results.

The particular phase to be dealt with in this discussion is that of machining allowance on castings. It forms a very definite link between the machine department and the foundry, and the amount of consideration shown by the one branch inevitably lightens the burden of the other. It is sometimes rather forcibly expressed by the machinist that the founder puts extra material on his castings in order to make sure that possible defects may be removed during the process of machining, and the founder declares with equal frankness that it is put on to give the machinist plenty of material to play with; perhaps somewhere at the back of his head he has an idea that it is possible to err in the setting up of a job.

However it may be expressed, all must be agreed that some allowance is necessary for the ultimate success of the product, not only on account of custom, but because a little reflection on the matter will convince one that it would be impossible to "carry on" without it, and opinion will vary only as to the amount allowable under certain conditions. It is conceivable that there are few, if any, operations known to man in which it is not necessary to leave extra material on for subsequent removal—it is practically essential to most operations, and the cost of the appliances, or of the operation itself, rises rapidly with the decrease in the amount of the material to be removed, and the degree of accuracy required.

Pattern-Shop Procedure.

One might follow a particular article through the various stages of its creation; thus from the pencil sketch to the finished drawing or tracing; then to its treatment in the pattern shop, where it takes form in pattern and core-box, the manner depending on the question of cost and expediency. If the founder is prepared to make sacrifices at this stage, then a pattern may be made in skeleton form, that is, a rough outline of the shape may be constructed with wooden ribs, leaving the intervening space to be filled in afterwards with sand by the founder, or a further step would be to make a soft wooden pattern. This, however, would carry with it the risk of subsequent variation; or, to proceed further on the journey towards accuracy, a pattern might be made in hard wood with the chances of long life increased and the risk of variation considerably lessened. The final effort of the pattern shop might be to provide a pattern made of metal, one with reasonable prospects of accuracy throughout its life. Additional aid may be sought with this object in view at the hands of the die maker or spinner.

Every advancing step is taken with the object of securing closer conformity to design in the operations which are to follow, but it should be noted that this advancement carries with it increased cost, according to the method employed.

Eliminating Variables.

Similar conditions operate as far as the founding is concerned. Commencing with the pattern in its skeleton form, and probably used with improvised tackle; on to the loose pattern and working with indifferent moulding boxes, and then going a stage further with the pattern secured to a board or plate and operated in boxes with perfectly true joint and well-fitting pins, or else by making special provision (depending on the shape of the article and the quantity required) for it to be mounted on a modern moulding machine, with its tackle specially designed for accuracy and durability.

There are, of course, many other methods falling between those mentioned, but all have broadly the same object in view, namely the elimination of dimensional variation and the assumption that the increased expenditure may be justified.

Finishing Conditions.

The casting, which is the result of all this effort, has still other stages to go through before it is in a fit condition to leave the foundry. The adhering sand has to be removed, and the manner in which this is dealt depends on the degree of cleanliness designed by the machine shop. Brushing may suffice for some, others may prefer rumbling or shaking, whilst quite a number will insist on sand-blasting. Lastly, the pickling method is not without its adherents.

It has now reached a stage in its journeying when it will have to "sit up and take notice." It may have had the crudest treatment, and as a result may not be "fair and good to look upon," or it may have been produced on as near scientific lines as the present state of advancement will allow with modern equipment and up-to-date methods. Whatever the means of its production, its fate is in the hands of others, who may as yet have no sentimental feelings towards it. The founder bids farewell to it, but there may be no finality in his tones; he may perhaps see it again, and under less happy conditions.

Machine-Shop Care.

It carries with it, however, that extra little bit, which is the subject of this discussion; that little bit upon which the whole wonderful machining organisation has been built. The surplus material that it has will stand in good stead for the remainder or the journey.

The machinist will take careful note of the amount of this surplus he has to remove, and will take steps for its removal. Not all at once; not at one operation, because he, too, must have latitude; but after each stage is passed the casting will carry material allowance for the next in order to facilitate work at subsequent stages. Roughing cuts will be followed by finishing cuts; these may lead on to grinding, but safeguards will be left in the shape of surplus material in order to ensure its ultimate accuracy. He may not trust entirely to mechanical means, but will prefer to scrape it to his own satisfaction. It is left to the erector to assemble it in its correct position, and he, too, may need an allowance to be made for his portion of the work in the form of chipping strips.

All this is, of course, very elementary, but it is sometimes helpful to refresh one's mind on matters of even every-day procedure, and the intended object will be served if the fact that allowances have to be made at each and every stage of production of a casting has been sufficiently emphasised and that this practice is not confined to the founding side alone.

Co-operation Reduces Costs.

It will readily be realised that such allowances can be kept to a very fine margin in a works with its own foundry, and with the drawing office, pattern shop, foundry and machining department working in close co-operation with one another and in a suitable atmosphere for the development of the team spirit. Under such conditions the drawing office may help both pattern shop and foundry by readjustment of non-essential details of design. The pattern shop also may be of great assistance to the foundry by a willingness being shown to carry a little extra expense in order to simplify operations in the foundry, and this latter department may often reciprocate by the use of strickle and other methods that tend to lower the costs in the pattern shop.

The passage of work through other grades of production may be expedited through the machine shop and the foundry working hand in hand with each other and by making departures from normal procedure in order to counteract variations which may occur in the practice of either. Conditions such as these do exist, and, although they do approach the ideal, the indications are that more and more in the future this spirit will be fostered. When, however, the castings are bought from detached foundries, differences cannot so easily be adjusted, and a spirit of toleration is not too much in evidence. The economic situation forces the founder to submit to limitations imposed by the buyer, very often against his better judgment. Under these circumstances an allowance certainly is granted, but no Papal Indulgence was ever granted so grudgingly. The founder may not even be consulted at all as to the amount of material to be left on for machining. There are exceptions, of course, but consideration is sometimes withheld until after some trouble has arisen.

It is not generally understood or else not appreciated by the buyers that an insufficient amount of machining allowed on a particular casting may cause just as much, if not more, trouble than if it were in excess, and the difficulty of getting under the skin will be recognised by all who have had experience in these matters.

Another aspect of this rather vexed question of allowance is the very widespread notion that the founder is out for an increased amount of metal in order to add to the weight of the casting (if he is selling by weight). This is far from the truth, and it must have happened in the experience of most of the founders present that in certain circumstances it would have actually been advantageous to them if the amount had been less.

In some instances the founder himself is to blame when he does not give the time and thought to the matter that he should. He accepts orders for work without clearly understanding the purposes for which it is intended, and works from patterns as sent to him with little regard as to the amount of machining allowed, and his interest is not aroused until the arrival of a debit note for defective work for which he is not perhaps entirely to blame.

Pattern Modification.

There is another misunderstanding which sometimes arises between the buyer and the seller of castings. which it may not be out of place to mention at this juncture, though not necessarily relevant to the subject.

The buyer is very often at a loss to understand, when he sends a pattern from which satisfactory castings have been produced to a foundry, why he is met with a request for it to be altered; he cannot quite see why, if it was

* A Paper given before the Keighley Association of Engineers.

right in one instance, it is not right in another. There are many right ways of making the same type of casting, and methods vary radically from foundry to foundry, and even in the same foundry at different periods. The type of work generally made in a shop, the class of tackle available, the amount of work going through at the time, core-stove accommodation, the special experience of the workpeople employed and many other factors are responsible for this seemingly illogical attitude. Founding is not as yet an exact science, and in the opinion of some it is an intelligent averaging of variables, which is true to some extent owing to the number of factors not under control, and an examination of some of these may be of interest.

Where an Increased Allowance is Desirable.

Reverting for a moment to the casting previously discussed, which may have been a plain flat base, simple in design, with only one or two surfaces to be machined, and of a size very unlikely to cause trouble for either the machinist or founder. An allowance of $\frac{1}{8}$ in. would be ample on a casting of this description.

On the other hand, it might have been a long, slender base, lightly constructed, with large, heavy overhanging mountings, one of those occasionally met with which cause so much anxious thought to the founder. There are several things he has to take into consideration in connection with castings of this type. He may bed the pattern in quite to his satisfaction, so that it is level, etc., but finds, when the casting is taken from the sand, that it has distorted, that the ends have curled downwards. Sometimes camber is allowed on the pattern by the patternmaker, but more often than not the founder has to rely on his own experience and take steps to bed in the pattern out of alignment in order to get it near to the desired shape. Under these conditions he is not always sure of a dead-level casting, and, if he says that $\frac{1}{4}$-in. allowance is not enough, his request for more ought to be agreed to without demur.

Apart from the variation during the cooling of the casting, patterns of this description are very liable to be rammed out of shape during the moulding operations, and it may be advisable to make a solid pattern and lighten out the necessary portion with cores. The facings on the mountings may be a source of trouble in a deep mould where the space is too restricted for it to be finished off as it should be, and a little extra allowance at these points is a distinct advantage.

The machinist will appreciate that, in the event of having to deal with a curved casting which rocks on his machine like a cradle, as he will probably inform one, that facings at the ends may be nearly removed and those in the middle may not clean up.

The position is a little more complicated in the case of machine-tool beds, slides or tables, on account of tee slots, bearings, facings and bosses placed in irregular positions and at various angles; even a simple slide rail may cause trouble on account of some distortion in the mould or casting.

A Difficult Casting.

One recalls a very simple casting, which proved to be quite a source of worry to those who handled it; it was in the shape of a flat plate about 6 ft. square, with flanges all round gapped at intervals for slides, etc., with facings and bosses on top and bottom of a plate $\frac{1}{2}$ in. thick; the flanges round the plate were 1 in. thick. The pattern, which was not one of the best, being very lightly constructed, warped to a considerable extent and the position and dimensions of the facings added to the difficulty of getting a straight plate. The casting was machined all round on the flanges, and the gaps in the sides had to be machined to a fine limit, some of the faces were to fixed limits, but others had only just to clean up. A normal amount of machining was allowed, but this was found to be quite inadequate. To get the flanges dead square, the gaps exactly parallel, and to leave the facings without a witness, was a task performed with the utmost difficulty and of course ate up the time allowed for the operations. Working against a promised delivery did not ease the situation. The task would have been different with well-made, robust patterns, moulding boxes made for the job, and with the designer working in conjunction with the founder.

The simple type of casting, cylindrical in form, can be made in a variety of ways, and, simple though it looks, it is full of possibilities as far as errors are concerned, and calls for special consideration depending on the method of moulding and its dimensions. If a fairly large one made by the strickle method, with loose lugs bedded in, an allowance of $\frac{1}{4}$ in. a side is not too much to ensure it being dimensionally accurate. If made from a pattern and core-box under normal conditions, $\frac{1}{8}$ in. a side might suffice, or if it was produced on repetition lines with metal patterns and with moulding boxes, a toolroom job, then so small an allowance as $\frac{1}{32}$ in. a side has been known to be enough for successful operating afterwards. However, to reduce the allowance to this small margin, great expense was entailed which would only be justified by a very large quantity being required from the same pattern. In this same class, liners would lend themselves to similar treatment according to the type of patterns and strickles, the state of the tackle in the foundry, the method of moulding, whether dry or green sand, loam, plate or machine moulding. A type of permanent mould may be the medium or the casting may be centrifugally spun.

Cylinder Castings.

In addition to the plain type of cylinder, complications may be introduced in the shape of valve faces, pipe attachments, door facings and the numerous bosses frequently met with in this class of work, all of which are subject to special care in connection with the question of surplus material.

The motor-car cylinder might be selected by some as one of the best examples of a complicated casting being produced with this surplus reduced to the lowest margin, and, like most of the units which go to make the modern motor-car, it has been the subject of most careful study and co-operation between the various interests whose lot it has been to handle it. A generation ago there were very few concerns who would undertake to handle the foundry side of this vast industry, and even to-day this trade is in the hands of a limited number of suppliers. The builders of the cars fought shy of it, and it was usually regarded as a class of work involving great risk at a cut price. To reach the standard of to-day has meant for those engaged in this business a tremendous amount of experimental and research work, and it can be safely assumed that for work that has to withstand severe service, this particular section of the engineering world is the last work in efficient production. If it were possible to effect any saving at all, it would most certainly have been tried out in this industry and machining allowance would have been cut down to the thinnest of films. It will be generally agreed that a low margin will actually restrict production on work that is operated at high speeds.

Working to Jig Location.

It is this class of work that has been responsible for the rapid strides that have been made in modern times in the use and development of jigs and other tools of the machine shop of to-day, and it is in this connection that one might call for a further word of sympathy for the founder. As the jig has become more and more a feature of the shop of recent years, so the elimination of the marker-off has been steadily taking place to an extent approaching extinction. As a consequence, to-day it is a common practice to clash a casting into a jig and expect it to locate itself without any regard for a fixed and constant point or without previously consulting the supplier.

A great deal of thought and expense is necessary before the foundry plant and tackle can be placed at the high standard which is essential to the method of locating, and it is unfair to treat a casting made under normal trading conditions as if it were the product of a foundry approaching laboratory standards.

Up to very recent years, when a scheme of mass production was decided upon and the details worked out for its efficient operation, it was very rarely that any attention worthy of the name was bestowed on the casting side of the project. Large sums of money would be earmarked for the purchase of single-purpose machines and their tool and general equipment. All the brains would be a work scheming how to squeeze in an extra piece of work in the same time in order to show what this particular machine was capable of turning out in a given time.

The patternmaker and the founder might be called in and told that a certain number of a particular article was required daily to feed this machine, and requested to get on with the job immediately. Usually they were told to get castings into the shop without delay. Money was lying idle whilst this machine was standing. Another exasperating aspect of this procedure was that a large number of castings had to be accumulated for this machine before setting up for a certain operation. Admittedly, a very wise course to take to lower the cost of a particular operation, but it did not always lower the prime cost, as very frequently quite a lot of unforeseen snags may result on account of demanding castings before due consideration could be given to their production.

Wheel Marking.

Other classes of automobile parts are produced under almost ideal conditions, especially pistons, valve plugs, wheels and similar units, but with the wheels which come under the attention of the jobbing or general foundry, the position is vastly different, and the need for varying the allowance for machining is very much in evidence. Most wheels, from the point of view of moulding, are simple affairs, but their size, construction or the service for which they are intended, may be a reason for widely different treatment. The rim of a wheel, for instance, may be required for use in a flywheel, gear wheel (with teeth cast or cut in it) or a rope drum or winch, and the method of handling it may vary for these reasons, as well as for its relation to the boss or the manner in which it is connected to the boss.

The method of moulding may be by strickle, or with a pattern or section of a pattern, depending on circumstances which are largely governed by questions of cost, utility and degree of accuracy desired. In the case of a wheel of considerable size, it is often an advantage to mould by the strickle method rather than use a lightly constructed pattern, even if a number of identical castings are required; the warping and winding of the pattern adds to the risk of distortion in the casting itself. Either way would involve discrimination as to the amount of material to be allowed for removal afterwards.

Should it be considered advisable to place pieces of metal in the mould in order to conduct the heat from a particular spot or spots, and thus regulate to some extent the rate of cooling, as is the case with denseners at the end of arms, etc., extra allowance may be made to counteract variation which may occur in the degree of density (which may approach hardness at the point of contact), due to the irregular placing of the cooler in the mould, the composition and the temperature of the metal, the position of

runner and the rate of pouring. In wheels in which teeth have to be cut in addition to the normal allowance for machining, it may be a great disadvantage if the teeth are deep and the pitch large, because of the risk of unsightly appearance in the event of penetrating the softer inner structure of the metal of large section.

The allowance on the arms does not often call for special care, as bosses and facing are usually the only machined surfaces; in a very light-armed wheel, however, there is a danger of the boss or arms being rammed out of position. A little extra might be allowed on the top side of a centre boss in the case of a cooled wheel if a risk of hardness is suspected at the points of contact with the cooler. It is customary to machine the under side (casting position) first, and it is as well to take precautions against any defect there may be on the top side, on account of the time expended in machining before the top side is reached. As regards the bore of the boss, if this is cored, the smaller the allowance the better.

Box-Like Castings.

One other class might be mentioned, namely, the box or hollow form of castings such as housings, casings and similar work. The conditions under which these have to be treated are as variable as their form. Most of the reasons for differential treatment already mentioned apply to this group, but one other may be worthy of mention, although not so commonly encountered. When a mould is made up of several horizontal parts, there is a tendency to increase in size owing to gaining a little at the joints, and it is the practice on these occasions to anticipate the risk of error by the use of a standard rule instead of one for contraction.

In this class of casting, too, there is sometimes a trouble met with of comparatively recent growth. The increased popularity of the grinding method of removing surplus material has brought with it a demand for the reduction of this surplus, and, whilst on the under side of the casting this can readily be met, it is not an easy matter dealing with the top side, for obvious reasons.

There is certainly a risk of distortion through the heat generated in the operation if too much is left on, but, on the other hand, the casting may not always be operated in this manner, and although little defects revealed by this process may pass muster, the tearing (relative) action of tooling by other methods will leave the casting in a less presentable condition.

But good may conceivably arise from this. There is no doubt that grinding and other advanced methods have come to stay, and as difficulties such as the one last mentioned become more common, people will want to know the reason why. In that event, if only they will dig down deep enough, the founder will come into his own and steps will be taken to give him better equipment to work with.

Cheeseparing Methods.

Broadly speaking, the "powers that be" are more than willing to provide plant for handling sand and other materials and will provide means of cutting out the heavy work such as ramming, but the provision of first-class patterns, moulding boxes and other essential part of equipment, is a matter that has not received the same amount of thought as, say, the provision, care and upkeep of the tools in a modern machine shop. So long as the founder turns out a job that will not cause too much trouble, he is allowed to carry on.

Special reference is here made to the general or jobbing foundry, and not to the repetition shop. The development of plant in shops of this description has been remarkable, and a number of industries have benefited to a large extent by the enterprise of the founders who cater for their requirements. Mention might here be made of the light-castings section of the industry. As an example of unmachined accuracy, the household bath is a marvel of craftsmanship.

As more thought and money is expended on foundry equipment, and the mental attitude in the foundry towards new innovations, approaches the ideal of the Institute of British Foundrymen, so the products of the foundry will require less and less attention from the machinist, and founders may reach a stage when castings will be transferred from the mould to the erector. Who knows? The activities of the machinist may be transferred to the foundry side, where a very large field awaits the inventive genius. Try to imagine a general and jobbing foundry with a jig and tool department working solely towards the improvement of foundry tackle and equipment, and one may be able to visualise what the foundry of the future may be.

Whatever the future may hold, one may rest assured that the prosperity of both branches of the industry will be more closely interwoven than at present, and founders will always welcome opportunities such as this—to come before the personnel of the machine shop and to further, as far as lies within their power to do so, the understanding of their mutual relationship in the industry to which they are proud to belong.

DISCUSSION.

MR. BINNS (the chairman) said that motor-car cylinders had been mentioned, and these were certainly a most difficult type of casting. If one considered all that these cylinders had to withstand, this difficulty might be understood a little. Not only had they to take repeated explosions of gas, but were at the same time subjected to variations of heat—very considerable at the time of the explosion—and the effects of water from the outside added to the trouble. These conditions were of a highly destructive nature, yet it was often complained that the cylinders failed to combat them. Here was one point, the study of which would benefit both foundrymen and engineers if a thoroughly satisfactory article could invariably be produced.

Effect of Nickel.

MR. WISE, replying to a question as to whether he had any experience of the adding of nickel to cast iron, said that, whilst this was not altogether germane to his subject, it was in a wider sense closely connected with it. Personally, he had no large experience in that direction, but, speaking broadly, the addition of nickel to cast iron was beneficial; it would induce density if not strength to the casting, with softness for machining. He did not use it for general work, but was in agreement with the general opinion that the addition of nickel did reduce hardness and increase density.

MR. W. H. POOLE said that, in his opinion, nickel did not add to the strength of the casting, but an addition of ½ to 1 per cent. did improve the machining quality of the iron and gave a more even and dense structure. Nickel could be advantageously used for castings where machining was required, and at no sacrifice in regard to strength.

MR. J. SMITH, as a patternmaker, insisted that there was at present in most works no co-ordination to overcome the difficulties associated with machining allowances.

MR. WALTER SLINGSBY said that, when the whole question of machining allowances was considered under present conditions, the position seemed to be that the designing and management side had little real foundry experience, but arrived at certain conclusions from reading and a few weeks' experience in the works, and from this made their estimates and issued instructions to do this or that. The foundry and pattern shop had to work to rules and regulations, and often all were wrong. Where, then, did the fault lie? Speaking of his own early experiences, Mr. Slingsby said that in his early commercial life he was connected with a business which handled cast-iron mouthpieces for gas undertakings, all made to standard size. It was necessary to make certain alterations, and adopt a new standard mouthpiece. For this they were told to make the same allowances in every way as for the old model and to make an iron shell on these lines for the new type. This was done, with the result that, instead of the normal amount of contraction resulting, as had been estimated, the new model was less by ½ in. one way and ¼ in. the other. Mr. Slingsby made a blackboard drawing to illustrate his point, and then added that, by increasing the allowance by the exact amount of the deficiencies quoted, he secured his shell to meet the requirements of the new type.

The foundryman should be allowed to decide on the proper metal required for a certain job, so as to ensure the requisite quality, density and strength. Segregation of departments was not good for industry, and the buying department might with advantage co-operate. This department could not always visualise what their so-called reductions in cost as per theory really led to. The cost at works could in reality be reduced very largely if the foundryman was taken into consultation. Often, by being allowed, say, 5s. extra, the foundryman could save at least 15s. later on. It was essential that the engineering side should study the foundry side, and vice versa, so that, in conjunction with the buying department, the best results could be obtained.

MR. H. SAYERS said, as a jobbing moulder, that if he could co-operate with the patternmaker, he could always turn out a better job. There was undoubtedly a lack of collaboration between these two sections of the trade, and often, by simply following the draughtsman's instructions, waster castings resulted.

Top and Bottom Allowances.

MR. JAMES FEARNSIDE said that very often patternmakers gave the same allowance for facing on both top and bottom, of which no better illustration could be given than the wheel. The bottom face would clean up with very little on, whereas on the top a fair amount of allowance was required. It would lead to far less misunderstanding if patternmakers would take due note of any altered requirements which might affect the foundry and then pass on the information.

MR. POOLE said that, whilst he favoured co-operation in industry, he had so far heard no mention of the chemist, a man who must necessarily be included in the scheme of things. Certain jobs required varying types of metal, and co-ordination of ideas on these lines would be useful. If the engineer expected foundries to supply castings at cut prices, he should pay a little more attention at the same time to refinements, which saved much time and work in the shop. Co-operation was lacking, and for this reason the best results were not obtainable. Another point which needed more consideration was a definite check on the contraction of metal. This led to much trouble, which might be avoided by a little forethought.

MR. J. MCNISH said that, when an engineer went into a foundry, he went as a layman. Not very long ago, machining in its relation to cost was a much bigger factor than moulding, but this state of affairs had been eliminated by the machine man, and it was now a very rare case to find that machining even approached the cost of casting. All this has been brought about during the past 30 years.

MR. WISE said he did not altogether like the distinction between the engineer and the moulder, for, in regard to tackle alone, there was no comparison. Engineers had resort to machines which were not applicable in the foundry. He did agree, however, that the engineer had scored in being more articulate in his fight against difficulties, but up to now the odds had been on his side.

(*Concluded on page* 394.)

The Use of Welding in Repair Work.*

By Dipl. Ing. J. C. Fritz, Köln-Kalk.

Most workshops have nowadays a small repairing department, usually containing a forge, a drilling machine, a work bench with a vice, and a few tools. If the workshop is better equipped, it has in addition to the above a metal saw, a lathe, a milling machine, and perhaps a high-speed planing machine.

In these days when every manufacturer wishes to do his own repairs and to be independent of others, thereby saving costs, the purchase of such an item as an oxy-acetylene welding plant is very necessary. Unfortunately an electric arc welding plant is very rarely found in an ordinary workshop, although such a plant is much more important than many a metal working machine. The reason for the dearth of electric arc welding plants in workshops is because until recently only a comparatively few people have had any knowledge of the electric arc welding process, and the workings of the process have been carefully guarded; perhaps the foreman has had bad experience, having employed an inferior welder, and is therefore antagonistic to the whole process.

Under the present conditions, every repair shop should have not only an oxy-acetylene welding apparatus, but an electric arc welding plant, and also an experienced and responsible welder.

During the last year or so, many German towns have made arrangements for tuition in welding. The training in these classes varies considerably, particularly as regards the period of tuition. Some are so short that only the very elementary principles of the process can be taught. There are also welding classes for advanced pupils. These, however, can only be attended by welders who have already had sufficient preparatory training. The fundamentals necessary for the making of a competent operator are ability and intense training, otherwise welding can never be mastered. The oxy-acetylene welding apparatus in many cases is not so suitable as the arc welding machine. For over 20 years the author has been engaged in repair work, and for 15 years with electric welding, and he insists that the electric welding plant is as useful as a drilling machine or a lathe.

Just as firms have various tools, so ought they to have various types of welding plant. If a job cannot be done successfully with one, it probably can easily be carried out with another. However, there are owners of repair shops who think that as soon as they have bought a welding machine, and one of their employees has successfully passed a welding training, they are able to undertake any welding job, even the most difficult. Does one expect an ordinary doctor to carry out a difficult operation? Obviously one calls in a specialist. The same applies to welding. Difficult work should not be entrusted to an ordinary welder but only to an expert with many years' experience. As a matter of fact, many beginners try to do the most difficult jobs, and obviously, through their inefficient work, give welding a bad name. Especially during tuition should it be taught what is a simple and what is a difficult job. Simple jobs can be done by the beginners, but the difficult ones should be given to a welding firm which has the necessary installation, welders and experience, and which can give a guarantee for the work done. However, the best experts cannot give a guarantee in some cases, especially when it is a question of welding castings. There is, for instance, cast iron which cannot possibly be welded, and again, material damaged by fire, gases or steam. On the other hand, there are steel castings which can be welded. Sometimes steel castings break through fatigue. In such cases welding is useless, because if the break is welded another break will appear shortly at another place; the same usually happens with breaks caused through residual stresses set up when cooling. In these cases a new casting should be made.

Good results do not, however, depend solely on the machine or the welder, but on the material, *i.e.*, the right choice of the electrode is the most important factor. In this respect many firms commit great errors. Good electrodes are naturally more expensive than poor ones. Very often the manufacturer of cheap but poor electrodes obtains a sale solely on price, and the buyer thinks he has obtained a bargain, and falls into the trap. What is the result? If failures occur welding gets the blame, not the cheap electrode. Pence are saved with the electrodes, and pounds are lost through failures. A good welder can only get good results with good electrodes. It is, however, necessary for a welder to become acquainted with the material he is using before he is in a position to undertake a difficult job. If, for example, a welder has worked always with bare-wire electrodes, he will not be able to weld perfect seams with coated or dipped electrodes at once. He has to learn first, which, however, is much easier than the reverse way. The lack of knowledge amongst some engineers to-day regarding welding is to be deplored, and much money and time could be saved if the repair shops would use the arc-welding process more frequently.

* Extracted from the November issue of the "Welder."

European Copper "Famine"!

By "Onlooker."

Perhaps the most remarkable thing in an altogether abnormal copper situation is the astounding farce of a make-believe scarcity staged by the Copper Exporters' Incorporated in Europe. As soon as the price was brought down to 9½ cents buying developed on this side in a very promising manner, and, to begin with, the daily tonnage allocated for sale was fairly reasonable, but as the days went on and consumers still continued to make purchases, the copper association apparently grew alarmed at the amount of business passing, and set out to do their utmost to kill the demand by reducing the tonnage offered to a minimum. In some directions the buying movement has been referred to as a "scramble" for copper, but with the tonnage available so small that sellers have been "cleaned out" by 10 o'clock in the morning, it is not surprising that buyers with a modest fifty or hundred tons to cover have hurried up to secure what they wanted.

Anything more irritating to consumers than this system of doling out copper over the counter in pennyworths it would be hard to imagine, and the usual defence put up by the Exporters' Association, to the effect that consumers do not take advantage of the days when quotas are plentiful, will not wash on this occasion, for buying has been brisk from the beginning of the new price level, and in addition to the copper sold by the sales agents a heavy tonnage has been disposed of by outside interests. In spite of the fact that during the prolonged fall in copper values, consumers have suffered again and again through the failure of the producers to check the slump, and had no assurance that 9½ cents was going to prove the bottom, they elected to begin serious buying at that level, and the producers must be severely censored for their failure to meet the demand in a proper manner.

At the time of writing the effect of this "goading" of the consumers has been to create a panic atmosphere, as a result of which standard copper jumped up £4 in one day, while the official wire-bar price was advanced by a like amount. On the same day prices were withdrawn in America, and it was apparently as impossible to buy anything there as in this country, no matter what was offered. The price is now being talked up to somewhat fantastic levels, if one bears in mind that trade generally is far from good and the reserves of copper very heavy at about 600,000 tons. Much is, of course, being made of restriction, and it is now learnt that an agreement has been reached to cut down production by 20 per cent., operating from January 1 next, provided always that the necessary Government consent from Washington can be obtained. To this there does not appear to be any great difficulty, but it would be unwise to count upon the removal of all troubles in the copper situation as a result of a decision to curtail output, which for months past has been in excess of consumption.

Panic buying has recently forced the quotation up by nearly £12 in a week, but there are already signs that this was overdone and that consumers have bought in excess of their needs in certain directions. As mentioned above, the published figures of copper in stock admit to 600,000 tons, but in addition American fabricators, especially those allied to the producers, are carrying a lot of metal on consignment at their works which has figured as "domestic deliveries" at some time during the past few months. The plan to cut production may or may not be a success, but the recent advance in copper, if maintained, will certainly not be a help. At 9 cents, or possibly lower, curtailment, though it could never be popular, would have been accepted as a necessary evil, but at anywhere around 12 cents or higher the restriction programme is not going to make much appeal to the parties to this arrangement.

Quite frankly, the outlook for the consumers of copper is gloomy in the extreme, for these constant alarms, price recoveries and reactions are the very worst possible thing for trade, which needs, more than ever to-day, a fair measure of stability in price and an assurance that supplies will be available as and where required.

International Commercial Arbitration.

The International Chamber of Commerce, 38 Cours Albert I^{er}, Paris, recommends the inclusion of (and agreement to before completion) the following clause in the two appropiate languages on all foreign contracts:—

"All disputes arising in connection with the present contract shall be settled under the Rules of Conciliation and Arbitration of the International Chamber of Commerce by one or more arbitrators appointed in accordance with the Rules."

"Tous différends découlant du présent contrat seront tranchés suivant le Règlement de Conciliation et d'Arbitrage de la Chambre de Commerce Internationale par un ou plusieurs arbitres nommés conformément à ce Règlement."

"Alle aus dem gegenwärtigen Vertrage sich ergebenden Streitigkeiten werden nach der Vergleichs- und Schiedsgerichtsordnung der Internationalen Handelskammer von einem oder mehreren gemäss dieser Ordnung ernannten Schiedsrichtern entschieden."

"Qualsiasi controversia derivante dal presente contrato sarà risolta in conformità del Regolamento di Conciliazione e di Arbitrato della Camera di Commercio Internationale da uno o più arbitri nominati secondo le norme del Regolamento stesso."

"Todas las desavencias que deriven de este contrato serán resueltas de acuerdo con el Reglamento de Conciliación y Arbitraje de la Camara de Comercio Internacional por uno o mas árbitros nombrados conforme a este Reglamento."

Arbitration is open to all commercial firms whether or not associate members of the International Chamber. We are in a position to supply further information, or reference can be made direct to the Paris office.

Machine Moulding in a Jobbing Shop.*

By W. Scott.

To sustain the interest for those who were at the Middlesbrough Convention in June, the following has been added to the Paper, "The Production of Large- and Medium-Sized Iron Castings,"† read on that occasion by the author.

A great diversity of opinion is sure to be felt as to what constitutes jobbing-shop quantities. Perhaps this could be agreed to at once. For castings requiring a machine table 2 ft. 6 in. sq. upwards, then a quantity of 2 off is a typical jobbing-shop order, and, in the opinion of the author, can be considered suitable for machine production. This may appear a very small number for moulding-machine work, but is undoubtedly an economical possibility when tackle such as boxes, moulding boards, etc., are made suitable. For smaller work, that is, boxes about 16 in. sq., no less than 5 off each item could be considered suitable for machine moulding. A

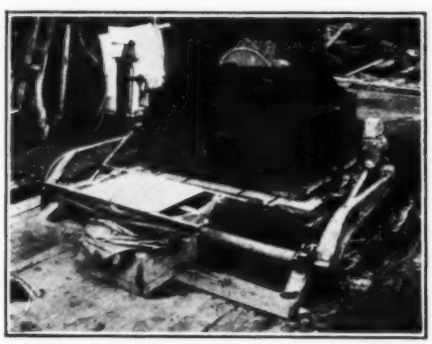


FIG. 1.—JAR-RAMMING MACHINE PRIOR TO JOLTING. NOTE TYPE OF BOX USED.

few of the advantages to be obtained by machine-moulding methods over hand production are enumerated below.

Advantages of Machine Moulding.

1. *Elimination of all Damage to Patterns in Use.*—This damage is, in the opinion of most deep-thinking foundrymen, almost a crime. Moulders, when slogging away with a quarter-hammer, often forget that a craftsman, equally as skilful as themselves, has taken great pride in the production of the pattern in the first place. There are other vital reasons why patterns should not be damaged, of course, such as the cost of manufacture, but it is postulated in this way because founders at heart like fair play, and a good deal of the damage visible on a pattern that has been in a jobbing shop does not come under this category.

2. Machine-moulded castings are more true to drawing, and are therefore on the whole lighter in weight, thus approaching to the customer's ideal. He is the man who buys the goods, and therefore his wishes should have first consideration.

3. The pattern costs for castings which are symmetrical in shape are a great deal less, as only a half-pattern is required.

4. All the pure manual labour is removed. This is a vital advantage, not with any pity or support for laziness, but from the point of view that any man using brute force cannot at the same time use his brains to the best advantage.

5. After many years' manufacture of castings, both with and without machines at one and the same time, it has been found that all items set aside for machine moulding receive a far greater amount of attention and thought in the lay-out of the runners, risers, etc. This is a reason that probably many will doubt, but it is a considered one.

6. The use of moulding machines in a well-organised shop forms a greater incentive to the adaptation of green-sand moulding than anything else. It is possible with a machine to use

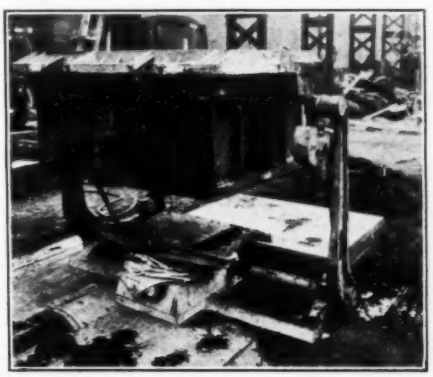


FIG. 2.—HERE THE PATTERN IS RAMMED AND THE MACHINE INVERTED.

moulding boxes twice or thrice daily if on green-sand work, whereas on dry sand each box is only used once in two days. This means four or six times the turnover for the same quantity of tackle. In hand moulding this is not emphasised nearly so much. The above reasons constitute sufficient inducement for the exploitation of the moulding machine in a jobbing shop.

Machines.

The most outstanding features of a good machine can be enumerated as follow:—

(1) It must be substantially built: this, of

FIG. 3.—THE CLAMPS HAVE BEEN REMOVED AND ALL IS READY FOR STRIPPING THE PATTERN.

course, is to keep down maintenance costs; (2) it must have a jolting capacity well up to the heaviest requirements of the work on which it is to be employed, plus a margin for a possible drop in pressure on the air supply; (3) its pattern-draw equipment must be made to stand in the rank of machine-tool work. It is generally agreed that the hydraulic type of pattern draw is the sweetest in action. Further, to allow for wear, it is better operating on one single-centre ram rather than on two side rams; and (4) the operation of the machine should be at once centralised point: this is necessary for the elimination of unnecessary walking during machine operation.

Box Plant.

For the larger type of moulding machines—that is, 2 ft. 6 in. upwards—boxes can hardly be made to be handled by hand unless some form of pressed-steel boxes are used.

Fig. 1 shows a good type of box. Its features are the vertical ribs running from the top flange to the bottom; the stout journal, and the two pin centres only which are used for centring. This box is made with provision for loose bars, which in themselves are fastened by means of wedges. When used as bottom boxes, no bars are of course necessary, and the cast-iron grid as shown bolted on this view is used instead.

Pattern Boards.

For jobbing work it is, of course, necessary to change the pattern a considerable number of times daily. It is, therefore, essential that some quick form of change-over is possible. This suggestion is working quite well in the Close works. On the machine table are screwed two steel bars which close-in slightly towards the

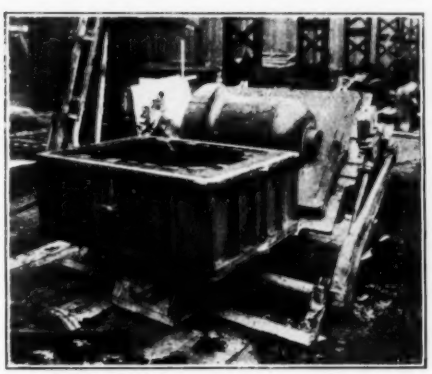


FIG. 4.—THE PATTERN HAS BEEN WITHDRAWN AND THE TABLE IS RETURNING READY FOR RECEIVING A FRESH BOX.

back side of the table, thus forming a tapering V slot. These are a permanent fixture, the dimensions of which are kept as standard in the pattern shop. The pattern boards then have two wooden strips of the same dimension fixed on the under side. When sliding over the pattern board on to the table, the slight taper takes a very firm grip and the board is as rigidly fixed to the machine table as if bolted down. As the pins are mounted on the board itself and not on the machine table, the exact position of the board to half an inch does not matter. When fixing patterns on these boards the centre line of the pins is essentially the centre line of the patterns. To remove the board, all that is necessary is a slight tap on the board at the opposite side. These boards may be used over and over again for different patterns.

The next few illustrations show the simple operation of the machine for the manufacture of safety-valve domes. Fig 1 shows the sand heaped up in the box prior to jarring operation.

The jolt having been completed, the machine has turned over the mould pattern plate and machine table in inverted position (Fig. 2). The clamps, it will be noted, are rather a novelty. In Fig. 3, the ram is in the top position and is taking the weight of the box and sand from the table, clamps have been removed, and, when the vibrator is put on, the first stage of the pattern withdrawing commences. Fig. 4 shows the pattern having been withdrawn, the table is on its way back, ready for the next box to be put into position.

Fig. 5 shows a typical group of work produced on a machine table 4 ft. by 5 ft. In the foreground are three locomotive-cylinder moulds in

* A supplementary Paper presented to the Newcastle Branch of the Institute of British Foundrymen, Mr. A. Logan presiding.

† See our issue of August 7, 1930.

various stages. The centre one shows merely the main steam-port cores in position. The right-hand one shows the lightening cores, etc., on either side, and the one on the left shows the completely cored-up mould ready for the cope, part of this cope is seen hanging in the crane on the right. Another point of interest here is the closing pins, which have a long handle at right angles to the direction of the hole. The usefulness of this is apparent without any explanation.

Fig. 6 shows a general view of a twin installation. The number of moulding boards to be seen give a good proof that it is a jobbing shop and not a mass-production department. [A film was then shown illustrating the complete operation of the machine, which is a Herman machine.]

As a matter of general interest, the next illustration (Fig. 7) shows the length to which the Americans have gone in the production of moulding machines for jobbing work. It shows a plain jar machine with table 18 ft. long by 5 ft. wide. In conjunction with this machine, the following extract is taken from "The Foundry," dated September 15, 1930, carries further interest:—"The classic remark of the individual who gazed upon a giraffe for the first time, and then, despite the evidence of his own eyes, flatly declared 'There ain't no such animal,' readily might be duplicated by showing the average foundryman a cast-iron pipe 12 in. dia., 16 ft. in length, cast horizontally in green sand, mould and cores, without the use of chaplets. Offhand, the practical foundryman, accustomed to the tremendous pressure exerted by iron in the molten state, will declare that the production of a pipe of that kind is outside the range of practical accomplishment. The core either will sag in the centre and cut through on the bottom, or the pressure of the molten metal will bend it upward in the centre and cause it to cut through on the top.

"'No, sir,' he will declare most emphatically. 'No cast-iron pipe can be moulded in that manner. Short lengths, 6 ft. or 8 ft. maybe, yes, on extra-strong cast-iron arbors; but 16 ft. horizontally without a support for the core? Man, there simply ain't no such animal.'

"Confronted by a carload of these pipes, all absolutely straight, with a uniform thickness of metal throughout, and all conforming to the strictest specifications governing cast-iron pipe, he grudgingly may admit his belief in the statement that the pipes were produced as described, but he will add a rider to the effect that the whole thing is uncanny and that there must be some trick about it.

"Certainly there is a trick to it, but, since the trick has been responsible for the establishment and continued growth of a business with a present capacity of 100,000 tons of pipe per year, it is not surprising to find that it has been patented by J. R. McWane, president of the McWane Cast Iron Pipe Company, operating plants in Birmingham (Ala.) and Provo (Utah)."

Fig. 5.—Moulding Boxes prepared on a 4-ft. by 5-ft. Jarring Machine. Note the novel Closing Pin.

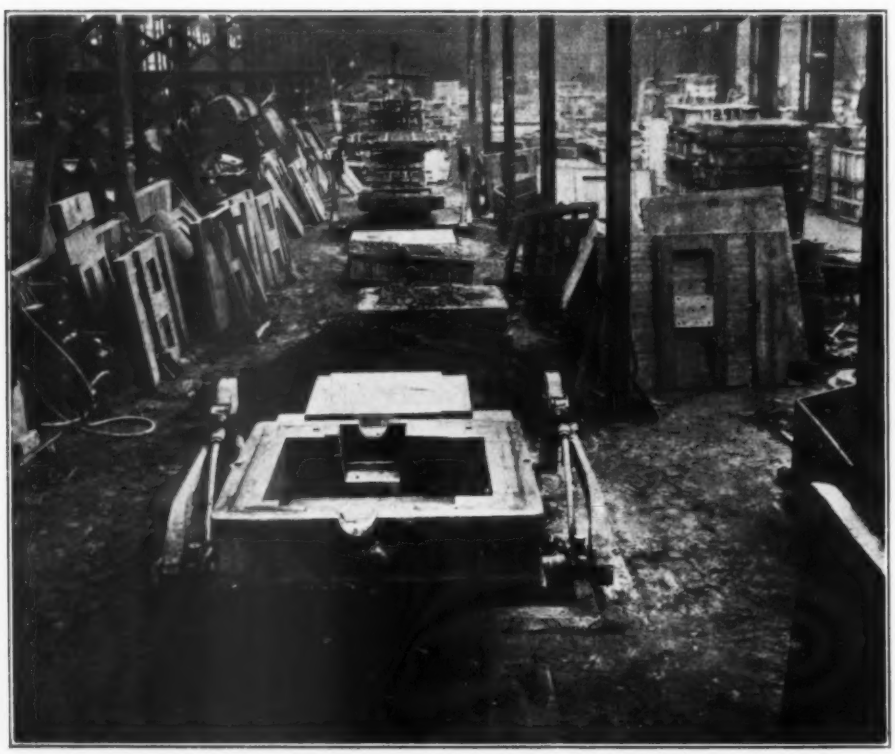


Fig. 6.—The Interest of this View is the Number of Moulding Boards, showing that the Work is purely of a Jobbing Character.

It looks as though that trick is worth knowing. This (Fig. 7) is the machine that was used in the production of that tonnage. Speaking generally on moulding-machine work, the most disappointing thing after one has installed the machine for the first time, is to find the machine itself is actually only working about one hour per day. This is caused, in the main, through lack of proper auxiliary machinery working in conjunction with the moulding machine. On taking a time study of a moulding-machine job in a new installation, one is apt to find something like the following:—

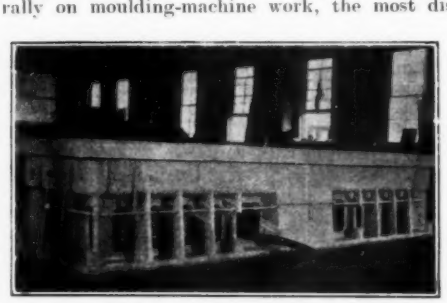


Fig. 7.—An American Plain Jar Machine having a Table 18 ft. long by 5 ft. wide.

Filling the box with sand ..	10 minutes.
Jarring machine at work ..	30 seconds.
Roll-over	Perhaps 10 seconds.
Pattern withdraw and table returned to normal ..	Say 30 seconds.

(*Concluded on page* 394.)

Foundry Problems.

The proceedings at the meeting of the Lancashire Branch of the Institute of British Foundrymen, held on November 1, took the form of an open discussion on foundry problems submitted by local firms. It could not, however, be described as a successful experiment from a debate point of view, owing to the lack of details given by the writers of the various queries submitted. Mr. R. W. Stubbs (President) was in the chair.

Problem No. 1—Turbine Casing Defect.

The letter stated: "*We are submitting a problem which has from time to time given trouble in our foundry practice, and we think this subject will be a very interesting one to discuss, as we are sure it is a troublesome matter to all who are manufacturing turbine castings of this description. We enclose herewith a full-sized section of an I.P. turbine casing showing the grooves at A, B, C, D, E and F. These grooves, when machined, invariably disclose spongy metal on the uppermost parts of the cylinder bore, whereas other grooves cut in the even section of the barrel are perfectly sound. The trouble in grooves A, B, C, D, E and F is, in our opinion, due to the change in section of the metal, and we think a discussion on the*

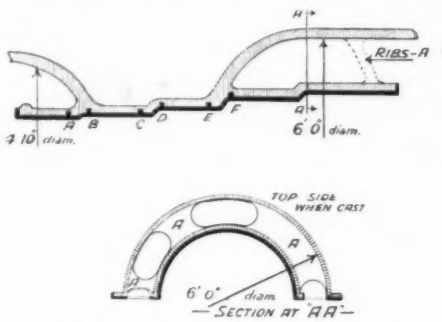


FIG. 1.—SKETCH ILLUSTRATING PROBLEM NO. 1.

best methods of eliminating this defect would be a most interesting one to all those who are manufacturing castings of this description. The discussion we suggest might proceed on the lines of what may be considered to be the best method of feeding these parts to produce perfectly sound castings at these portions."

A typical analysis of the turbine casings was: T.C., 3.33; Gr, 2.63; C.C., 0.70; Si, 1.46; Mn, 0.83; S, 0.068, and P, 0.44 per cent.

Answering questions, the representative of the firm submitting the problem stated that the job was carried out in dry sand and the castings were run on a bottom flange with three gates to each side.

MR. MASTERS said he took it the recess seen in the drawing was for the turbine blade, and that was where the porosity occurred.

The representative replied that that was where most of the trouble occurred.

MR. MASTERS asked whether experiments had been made with different mixings of sand for the particular corner affected. It was running through his mind that possibly a certain amount of heat was retained there which might have the effect of causing a growth of the graphite.

The representative said they had tried many different mixings without success.

MR. MASTERS: Have chills been tried?

The representative of the firm replied that in this particular class of work the use of chills was not permitted. In answer to further questions he stated that the casting temperature was in the region of 1,390 deg. C., and the lower they reached below that the more porosity there was. Straight casting iron was used without any steel addition.

MR. PELL suggested that there was a possibility of overcoming the difficulty, so far as porosity was concerned, if the slots could be cored out. Even if the process of coring them out took a longer time it would be cheaper in the long run because the casting would be saved.

MR. PHILLIPS said that one solution of the problem might be to load the sand at the part where the porosity occurred with steel shot. If chills were not permitted no objection could be offered to the use of shot in the sand.

The representative of the firm replied that that really meant using a chill or semi-chill, and it was not permitted.

MR. DUDLEY remarked that it was essential the sand should be kept as cool as possible while the metal was setting.

MR. LONGDEN said he had made this particular class of casting, but had used chills. He appreciated the danger arising from the incorrect use of chills, including the liability to hair cracks where the chills met. He understood the castings were machined in the works. He had never had any objection raised to the use of chills, and one method which avoided some of the difficulties met with occasionally was to chill on the opposite side to the machined surface. The proper distribution of runners would also help if they were run in two places. The quicker the job was filled with due regard to the proper sealing of the metal, the better the results.

The Representative: What depth of chill do you think we could get on the face of such a casting?

MR. LONGDEN: What is the section of the metal?

The Representative: 1⅞ inches.

MR. LONGDEN said it had to be remembered that a low-silicon iron was being used. Personally he should have small short blocks of chills about 1 in. square and place them in the spots which would be the last to solidify. It would really be densening, not chilling. One point would be to avoid chilling the extreme points if possible, and that could be done by shaping the chills to just those points. He would reduce the silicon content to 1 per cent. if chills were used, and it would be wise to reduce the manganese to 0.6 instead of 0.83 per cent. Problems of this sort were not easy to solve, because there were so many points to be taken into account.

The representative remarked that the difficulty was gradually being overcome, and it was not as bad as it was four or five years ago.

Problem No. 2—Running C.I. Pipes.

"*Which is the best way of running cast-iron pipes? I enclose five sketches. What is wanted is a pipe to stand the pressure. The running of the pipes has a great deal to do with it.*"

MR. LONGDEN remarked that the magnitude of the problem depended on the dimensions.

The CHAIRMAN said there were no dimensions given.

MR. HOGG remarked that in the case of a delivery pipe the way to run it successfully was to have the runner up the edge of the print if the porosity was on the body of the pipe. If the metal was poured in as hot as possible, not a dazzling white, with a clearance up the body of the pipe with suitable metal, there should be no porosity, or, at any rate, only an average of 2½ to 3 per cent. As regards flanges, some machine shops insisted that they should be as soft as butter. The price of pipes was very low, and as they had to be machined very quickly a low-silicon iron was used.

Problem No. 3—Gun-metal Castings.

"*In our production of non-ferrous castings we are sometimes asked to produce gun-metal castings to the Admiralty specification: 88 copper, 10 tin and 2 per cent. zinc, with physical properties of 16 tons tensile, 8 per cent. elongation. Can any of your members give us any method that will enable us successfully to obtain the physical tests on the standard bar? We use electrolytic copper, best tin, best zinc. We make the test-bars horizontally in dry sand and use a runner at one end with a riser at the other; pouring temperature 1,160 deg. C. With all the precautions we take there are periods when we have failed with the test.*"

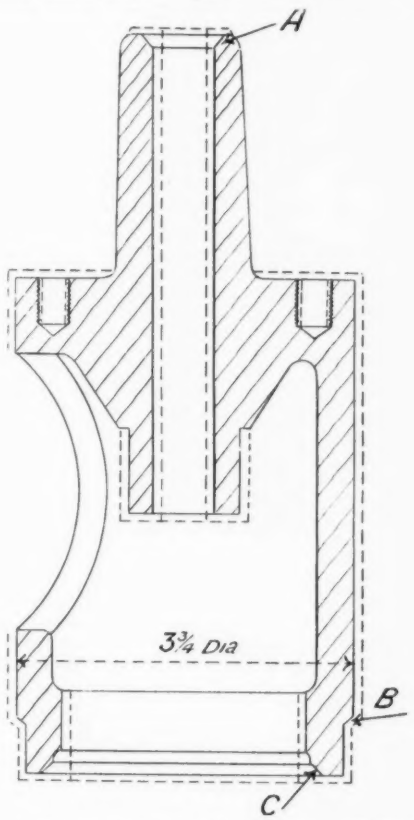


FIG. 2.—SKETCH ILLUSTRATING PROBLEM NO. 5. FACES TO BE MACHINED ARE INDICATED BY THE BROKEN LINE.

MR. PRIMROSE said he had had to deal with quite a number of castings of this type. The temperature of 1,160 deg. C. was, in his opinion, much too high for large castings, and about right for one of, say, a few pounds instead of tons. A temperature of round about 100 deg. C. lower would be quite satisfactory for a large

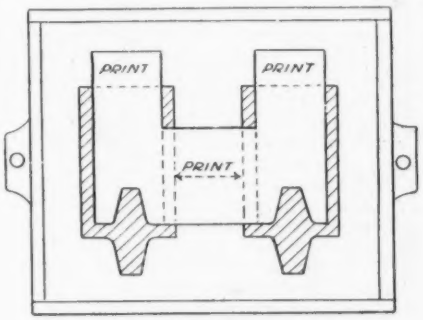


FIG. 3.—SUGGESTED METHOD FOR ELIMINATING STUDS WHEN MAKING THE CASTING SHOWN IN FIG. 2.

casting of about 9 cwts. The method of mixing had much to do with the class of casting that was produced. If a small casting was being made the melting should, for preference, be done in a crucible where the temperature was controlled by a suitable oil burner rather than by the use of cold firing, and it was best to use a

flux on the top. Casting in dry sand, although satisfactory for the casting itself, would not always answer for a test-bar which had to meet such a high tensile test as that specified in the problem. The real point to be watched in cases of low tensile was not to stew the metal. Gun-metal was one of the things people seemed to like to get ready long before the mould was prepared, whereas the reverse ought to be the case. The mould should be first prepared and then the metal mixed. The order of melting was not stated in the question, but it would be important, before giving any definite advice, to know in what manner the mixing was done. In his opinion the copper should be melted first, then the tin put in, and lastly the zinc, to do the necessary clearing of any possible oxides. The introduction of a little boron-copper into the crucible degasified the melt and made it cast soundly.

The important points were, not to stew and to cast quickly; by that method the tensile should be 22 tons per sq. in. instead of 16 and the elongation about 14 instead of 8 per cent.

Mr. Hopwood remarked that the casting of gun-metal required very careful supervision if a good cast was to be obtained each time. The firm stated that they cast in dry-sand moulds and that, according to his experience, was against good practice. Really it should be done in a green mould in order to get quicker cooling, and as many runners as possible should be used so as to get the metal without overheating at any particular point. Good feeding-gates were necessary, and if there were any heavy lumps a good riser was needed. With regard to test-bars, the best method was to run them horizontally with a riser at each end and, as Mr. Primrose had stated, get the metal in as quickly as possible. Of course, if chills were used there was a little more latitude as regards casting temperature.

Problem No. 4—Loam-Moulding Procedure.

"*We are making a small amount of castings in loam, and we shall be pleased to know which is the better practice, to black the cores and moulds before or after drying in the stove. In our loam we have approximately 15 per cent. of manure. This in some cases appears to give a marked surface on the finished castings. Any information on this subject will be helpful.*"

In reply to questions, the Secretary stated that no dimensions were given and it did not state whether the 15 per cent. of manure was by volume or weight.

Problem No. 5—Porosity in Spindle Bore.

"*Specification: Close grey iron. Machined faces are shown by means of a dotted line. The ¾-in. dia. bore for valve spindle to be perfectly sound metal (lead capped to glass finish). Valve seats A, B, C and machined diameters faces of equal importance. This simple casting is submitted with some apprehension, but with the certain knowledge it is not so easy as it looks to produce 95 perfectly good castings out of each 100 cast, and the writer would ask, in the year 1930, Why not? A laboratory report states that the best results are obtained with metal having not more than 1.0 silicon and 3 per cent. total carbon. The inspection department reports the main faults as being that the spindle bore was porous and of variable colour, with unsoundness at the top of the casting—the stud-hole face. Various results have been obtained according to method of casting, and it recommends the core to be supported without chaplets or studs as with one core for two castings.*"

The Secretary remarked that it was not stated whether it was cast in green sand or dry sand.

A number of questions were put to the representative of the firm, who stated that they had not tried casting them with a ring gate at the bottom, nor had they used pencil runners. The diameter of the bore was ¾ in., and the main trouble occurred in the valve spindle head. One speaker asked whether the firm had tried making a soft-iron chill, casting it up and then machining it out after. That had been done successfully with small castings.

The representative replied in the negative, remarking that the question of cost would have to be considered.

Problem No. 6—A Coke Problem.

"*Coke agents are sending to the foundry by-product coke instead of Beehive coke, which in price should be lower by 6s. per ton. I should like to know which is the best way for the ordinary foundry foreman to tell the difference between the two cokes and have a check on the agent. Beehive is what we call 'tops and bottoms'; is this enough to find out which is which, or are there any other ways of ascertaining? Not one in ten foundries in the district had laboratories for making analyses.*"

Only one speaker offered any comment. He observed that Beehive coke always left on the upper surface particles of unburnt coal which was never found on by-product coke.

A number of slides showing the effect of denseness in casting were shown by Mr. Longden.

Machining Allowance on Castings.

(*Concluded from page* 389.)

Mr. Slingsby, in moving a vote of thanks to Mr. Wise, said that there was far too much stress at the present time on the "school" side of education, whilst far too little credit was given to practical knowledge. It was only when the technical, mechanical and practical were properly blended and in their true relationship that best results were obtained. It was an impossibility for any one individual to specialise in every branch of the engineering industry; each section must blend with the others for the common welfare.

Mr. Smith seconded, and, in response, Mr. Wise said that friendly exchange of views was always beneficial, and he thanked the Keighley Association of Engineers for giving him the opportunity to state his case.

Machine Moulding in a Jobbing Shop.

(*Concluded from page* 392.)

Therefore the total time taken to produce the mould is 21 min. 10 sec., whilst the machine working time is actually about 1 min. 10 sec. This is not an exact time study of a machine, but is something in general of what takes place. It will be readily seen from the foregoing that at least 10 minutes waiting for crane is sheer waste of time, and, therefore, careful consideration of crane equipment is necessary before installing moulding machines. In face of the filling time also, one would readily see that the adoption of overhead storage hoppers for sand are a necessity. This, of course, is easy on mass-production work, but it is just a doubtful point whether the same could be used to best advantage for jobbing work—of this the author has no experience.

This covers just a few of the points involved in the use of moulding machines for jobbing work, and the author personally would welcome a good discussion on this side of the business, because he feels that the foundries in the North are behindhand in this matter. In conclusion, the author would like to thank Messrs. Pneulec, Limited, and also Mr. S. E. Smith, for their kindness in loaning him the film showing the operation of the moulding machine.

Gledhill-Brook Time Recorders, Limited, Huddersfield, have received a contract for 149 time recorders for use in Admiralty dockyards. This is a repeat order, 138 machines having been supplied previously.

American Developments in Mechanical Cupola Charging.*

By Clement A. Hardy.

The first major improvement in charging practice for the foundry cupola consisted of improving the yard lay-out with bins and tracks so that charges could be made up on cars in the yard from the bins and delivered to the charging floor. The bins were served by overhead travelling cranes equipped with magnets for unloading scrap and pig-iron. Improvements were then made in the cars so the charges could be dumped into the cupolas direct from them without hand handling. This method did not properly distribute the charges in the cupola, however, and required some labour to level-off the iron charges and the coke.

Several forms of machines for better accomplishing the distribution of the charge were devised, among them side-dump chargers operating from each side of the cupola; bottom-dump cars running into the cupola and dropping the charge; skip hoists and other devices. These were used with varying success, and each of them eliminated a certain amount of hand labour.

Some fifteen years ago certain of the heavy melters conceived the idea of using a drop-bottom bucket in combination with an electric travelling crane to serve two cupolas, carrying the buckets into the cupola and tripping the bottoms, thus discharging the load. The buckets were loaded in the yard and picked up from the yard level by the crane. This type of drop-bottom bucket was followed by the introduction of the cone-bottom bucket which operated similar to the bell in a blast furnace, laying the iron charges around the shell of the cupola, where, as every experienced cupola operator knows, the best melting conditions prevail.

The Whiting Corporation, having developed the side-dump charger and the balanced type of charging car, adopted the "wishbone" charging system. In this, a wishbone-shaped casting holds the rim of the bucket while the bottom is dropped, thus eliminating all latches and triplines and making the operation very simple. With a proper system of coke hoppers, whereby the scale car carries the bucket under the coke shute, the labour is reduced to a minimum. The records show that daily melts of 300 tons in 9 hrs. are made up and charged into the cupola with five men, using one yard-crane man, one electric transfer-car man, one man putting in additions, one charging-crane man and one helper to hook and unhook. Several plants melting 100 tons a day use this system, using four men, and some smaller plants melting from 30 to 40 tons per day with a properly-arranged yard use but two men.

The use of cone-bottom buckets shows a marked economy in coke consumption over any method of hand-charging or other methods in former use. Records show that in stoveplate work, where very hot iron is required, with hand-charging from the same level, the intermediate charges of coke required were 7 to 1, and after the installation of the machines and the cone-bottom buckets these intermediate charges were cut 10 to 1.

National Shipbuilders Security, Limited, announces the purchase of three more shipyards for the purpose of dismantling, with restrictions on the sale of the sites that will prohibit their future use for shipbuilding. The establishments concerned are the yard of Messrs. Napier & Miller, Limited, Old Kilpatrick, Glasgow; the South Yard of the Ardrossan Dockyard, Limited, Ardrossan, Ayrshire (the company is retaining its North Yard); and the small shipyard and engineering business of Messrs. John Chambers, Limited, Lowestoft.

* Extracted from the "Iron Age." The author is mechanical engineer to the Whiting Corporation, Harvey, Ill., U.S.A.

Oil-Hardening and Air-Hardening Cast Iron.

(*Concluded from page 386.*)

fugally-cast material. The diagrams for the material in the hardened condition are much shorter, due to the lower breaking stress, more nearly straight, and showing no marked increase in curvature right up to the breaking point.

In the tempered material, tempered at the lower temperatures up to 375 deg. C., the diagrams differ from those of the "as-cast" material in that they are more nearly straight right up to the breaking point. At the higher tempering temperatures of 460 to 495 deg. C. the diagrams show the curvature in the higher stress ranges, characteristic of the "as-cast" material, but to a lesser degree. The absence of the marked curvature in the diagrams of the specimens, hardened and tempered at temperatures up to and including 365 deg. C., indicates that in this condition the material is stiffer and more nearly approaches the truly elastic condition. At the higher tempering temperature the material shows a tendency to approach the "as-cast" condition in this respect.

The included area of the curves has been measured by planimeter, and the areas are expressed in square inches at the original scale to which the diagrams were plotted. This area is regarded as being directly proportional to the energy absorbed in breaking the specimens. The results show the diminution in area from the "as-cast" to the hardened condition, and the recovery to values approximating the "as-cast" condition in the hardened and tempered specimens. The area of the curves at the higher tempering temperature of 495 deg. C. is slightly lower than that of the original material in the "as-cast" condition.

That of the intermediate tempering temperature is higher, and that of the lower tempering temperature is approximately the same. The area of the curve for the hardened condition is very much lower than the "as-cast" condition. These curves indicate that, although the strength both as regards ultimate breaking strength and energy absorbed in breaking after hardening and tempering is not greatly impaired, the material behaves differently in the manner of its breaking, being stiffer and more truly elastic right up to the ultimate breaking load. The best results are obtained in this particular instance at a tempering temperature of 375 deg. C., where the ultimate breaking strength, the energy absorbed in breaking, are actually greater than in the "as-cast" material. In this case the material is definitely stiffer and more truly elastic right up to the breaking load. At the tempering temperature on either side of this value, the strength values are slightly less but not greatly impaired, the higher tempering temperature having the greatest effect, and being accompanied by a reversion to the less stiff and less truly elastic properties characteristic of the "as-cast" material in the region of the higher stress values.

Microscopic Examination.

The value of microscopic examination in following clearly the structural changes in these alloy cast irons is to some extent reduced, owing to the fact that the material has been prepared by the centrifugal process. For this reason the structures are so fine as to be only partially resolved at even very high magnifications. The following results were obtained from the microscopic examination of another more complete series of heat-treated oil-hardened and tempered nickel-chromium cast iron of the following composition:—C.C., 0.44; T.C., 3.39; Si, 2.25; Mn, 0.63; P, 0.37; Ni, 2.44; and Cr, 0.51 per cent.

Sample 1. *"As-cast" Condition.* This specimen had a matrix of very finely-laminated pearlite, which was only partly resolved at a magnification of 1,000 dias. The graphite was in fine flakes, arranged in clusters. No ferrite was present.

FIG. 6.—MICROSTRUCTURE OF SAMPLE 1, "AS-CAST" CONDITION. TYPICAL AREA. ETCHED PICRIC ACID. × 1,000 DIAS.

FIG. 7.—MICROSTRUCTURE OF SAMPLE 4, HARDENED AND TEMPERED AT 100 DEG. C. TYPICAL AREA, SHOWING MARTENSITE AND SORBITE. ETCHED PICRIC ACID. × 1,000 DIAS.

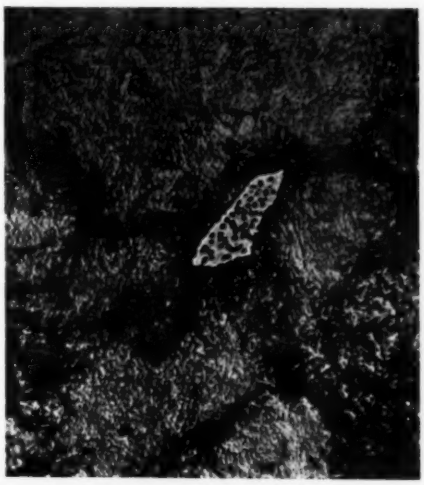


FIG. 8.—MICROSTRUCTURE OF SAMPLE 10, HARDENED AND TEMPERED AT 500 DEG. C. TYPICAL AREA, SHOWING SORBITE. ETCHED PICRIC ACID. × 1,000 DIAS.

Sample 2. *Normalised.*—The pearlite in this specimen was slightly coarser than in sample 1, but was not easily resolved at 500 dias. The graphite was in small clusters, similar to that in sample 1.

Sample 3. *Hardened.*—This specimen had a matrix of martensite and sorbite, and could not be easily resolved at a magnification of 1,000 dias. The graphite flakes were finer and in larger clusters.

Sample 4. *Tempered at* 100 *deg. C.*—The sample was very difficult to resolve successfully, but appeared to contain martensite with sorbite and other decomposition products of the austenite. The graphite appeared slightly coarser than in the previous sample.

Sample 5. *Tempered at* 250 *deg.* C.—This sample had a very similar structure to sample 3, with a little less martensite and more sorbite. The graphite flakes were somewhat coarser.

Sample 6. *Tempered at* 300 *deg.* C.—This sample had an all sorbitic structure, which would not resolve at 1,000 dias. The graphite flakes were small and in clusters, very similar to those in sample 1.

Sample 7. *Tempered at* 350 *deg. C.*—This sample had a matrix similar to that in the previous sample, being a little coarser and easier to resolve. The graphite flakes were definitely coarser, and the fine cluster graphite was not present.

Sample 8. *Tempered at* 400 *deg. C.*—This sample was similar to sample 6 in structure. The sorbite, however, was noticed to be breaking down, minute areas of coalesced carbide being present.

Sample 9. *Tempered at* 450 *deg. C.*—This sample was found to have a structure somewhat similar to previous samples.

Sample 10. *Tempered at* 500 *deg. C.*—The structure of this sample was found to be sorbitic, with some evidence of pearlite in a network formation associated with the phosphide eutectic. The graphite was mainly in fine clusters.

Sample 11. *Tempered at* 600 *deg. C.*—The structure of this sample was similar to samples 4 and 9, except that it contained areas of ferrite containing coalesced carbide.

The photographs, Figs. 6, 7 and 8, illustrate respectively typical areas of samples 1, 4 and 10.

General Remarks.

Apart from the demonstration of weakness and brittleness of the material in the hardened condition provided by the test results, ample confirmation of this was to be had from the experience gained in handling the specimens. In all cases the hardened specimens were found to be exceptionally brittle during handling. On the other hand, whilst it is realised that the specimens used were quite small, no trouble has been experienced from hardening cracks.

The presence of internal stress in specimens of ring form is generally indicated by a movement of the homes of the ring from a normal position on slitting. Whilst in a number of cases very slight movements have been noted, the whole of the specimens referred to in the above tests showed no movement. In those cases where movement has been noted, its magnitude is no greater than that observed in ordinary untreated samples.

Summary.

An investigation of the strength properties of certain nickel-chromium alloy cast irons having oil-hardening and air-hardening properties has been made, and three typical examples given. The Brinell hardness values are increased substantially over those in the "as-cast" condition by hardening treatment. The Brinell hardness of the hardened alloys is

diminished by tempering, the higher the tempering temperature the lower the hardness value, within the temperature range of the experiments.

The tensile strength values are seriously diminished by hardening. Tempering after hardening is accompanied by a recovery of the tensile strength values. The area included by the stress/deflection curves is influenced in a like manner. The modulus of elasticity (E$_n$ value) is found to be slightly diminished in the hardened condition, but is recovered after the tempering treatment. The stress/deflection curves disclose that the material in the hardened and tempered condition is stiffer, and approaches a more truly elastic condition right up to the breaking point. In the examples investigated the best strength properties are developed after a hardening and tempering treatment at a temperature of 375 to 385 deg. C. Quantitatively, the strength properties are slightly better in this than in the original "as-cast" condition. The structure of the hardened and tempered material is principally sorbitic.

Finally, the investigation shows that nickel-chromium cast irons, cast by the centrifugal process, can be hardened and tempered to develop higher ranges of Brinell hardness accompanied by a sorbitic structure. When hardened and suitably tempered the strength properties are definitely satisfactory.

It is pleasing to acknowledge the author's indebtedness to the directors of the Sheepbridge Stokes Centrifugal Castings Company, Limited, for permission to publish these results, which are taken from a comprehensive investigation into the properties of special cast iron for cylinder liners carried out in these works and laboratories.

Foundrymen Visit Coventry Works.

The Birmingham, Coventry and West Midlands Branch of the Institute paid a visit on November 24 to the works of the British Piston Ring Company, Limited, Coventry, where a close inspection was made of the sand and centrifugal-casting foundries. Special interest was taken in the various lines in which the firm has specialised, these consisting principally of pistons, cast-iron bar, valve guides and chilled tappets, together with centrifugal castings for piston rings, cylinder liners, valve seats and brake-drum liners. The centrifugal department was especially busy.

After a very rapid inspection of the machine shops, where the manufacture of piston rings and the machining of cylinder liners from centrifugal castings were the outstanding items of interest, the several parties joined for tea in the works canteen, where Mr. Lindley, deputising for Mr. Oubridge (the managing director), who is on a business trip to Australia, welcomed the visitors and apologised for the absence of his co-director (Mr. Hill), who was indisposed. Mr. A. J. Viner (works manager) and Mr. F. C. Pearce (foundry superintendent) accompanied the members round the works.

A vote of thanks was proposed to the British Piston Ring Company, Limited, by Mr. A. Harley (President-Elect of the Institute) and seconded by Mr. F. J. Cook, and was passed by acclamation. Later in the day the members gathered at Coventry to hear Mr. A. E. Berriman speak on "Apprenticeship."

Trade Waste Recovery.

The Institute of Chemical Engineers have organised a conference which is being held to-day and to-morrow on the subject of the Utilisation of Trade Wastes. Mr. J. Arthur Reavell is presiding. A Paper, "The Recovery of Metal from Waste Material," by Mr. J. W. Hinchley, is mainly concerned with tin.

The A.W. Semi-Rotary Open-Flame Furnace.

The A.W. semi-rotary open-flame furnace, illustrated in Fig. 1, has been designed to meet the requirements of small brass founders requiring an output of 1 to 1½ tons per day of non-ferrous alloys. The furnace is comprised of a steel barrel, lined with suitable refractory bricks or rammed plastic material, into which two burners, either gas or oil, fire directly opposite each other. The resultant flame is of a very good reverberating and blanketing nature, thus resulting in rapid melting and low fuel consumption.

A considerable saving is obtained owing to the elimination of crucibles, the metal being melted in the lining of the furnace. Charges from 50 to 400 lbs. can be very conveniently dealt with, with corresponding low fuel costs and efficiency.

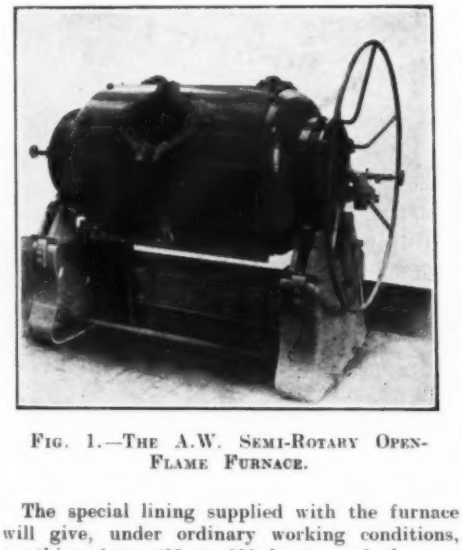


Fig. 1.—The A.W. Semi-Rotary Open-Flame Furnace.

The special lining supplied with the furnace will give, under ordinary working conditions, anything from 600 to 800 heats, and the cost of re-lining should not exceed £4 to £5. The furnace is specially designed to facilitate re-lining, and is of very robust construction, the principal parts being made of steel. It is suitable for either gas or oil firing, an air pressure of 1 lb. per sq. in. being required in both cases.

The furnace is of British manufacture throughout, and is produced at the Scotswood Works of Messrs. Armstrong, Whitworth & Company (Engineers), Limited, Newcastle-upon-Tyne. Furnaces of 1,000-lb. (brass) capacity have been in constant use in this and other foundries for some months. The furnaces are manufactured in two sizes, which in terms of brass capacity hold either 350 or 1,000 lbs.

Foundry Spats.

Messrs. S. Pulzer & Son, Limited, 45, Hatton Garden, London, E.C.1, have sent for our examination a new type of moulders' spat, which has recently found much favour in the foundry industry. Primarily it is made of light-weight flexible asbestos, suitably reinforced, and gives adequate protection to lace holes. Variations in the wearer's calf-thickness are taken care of by three slots in two light steel strips, mounted at the top and bottom of the spat. Into a pair of these a vertical steel strip slips in for attaching to the leg. Thus release is virtually instantaneous. We are quite satisfied that the design gives a maximum of protection for those in contact with liquid metal.

Yorkshire Foundrymen Visit Brighouse Works.

The first works visit of the West Yorkshire Branch of the Institute of British Foundrymen was that to Messrs. J. Blakeborough & Sons, Limited, valve makers and general engineers, of the Woodhouse Works, Brighouse. The party numbered 70, and was received and welcomed by Mr. W. Boyd (works manager) and Mr. C. Brotherton (export manager). The tour of the works was conducted by several members of the staff, and visitors were afterwards entertained to tea by the firm. An interesting Paper by Mr. Boyd and Mr. Brotherton was then presented in the works canteen by the latter.

Vote of Thanks.

Mr. H. Sayers (Branch-President), presiding, said that the Blakeborough valves seemed wonderful pieces of engineering. It was gratifying to realise that they were entirely British products.

Mr. W. G. Thornton (Immediate Past-President) said the gathering was indebted to Messrs. Blakeborough & Sons, Limited, not only for an extremely interesting Paper, but also for the remarkable freedom with which questions had been answered during the works inspection. He had seldom been so impressed by the candour with which any desired information was given. Visitors probably had been surprised by the wide range of products manufactured by the Blakeborough works. He had great pleasure in proposing hearty thanks to the firm for their hospitality and to Mr. Boyd and Mr. Brotherton for their excellent Paper.

Mr. W. Parker (Past Branch-President) seconded the proposal.

Mr. Brotherton, replying to the vote of thanks, remarked that the valve with which they had chiefly dealt in the Paper was partly British and partly American. It originated in the United States, but all the adaptations had been invented by Messrs. Blakeborough's own staff at Brighouse. The firm had nothing to fear from giving full and frank details in answer to genuine inquiries. Personally, as one who was engaged in the difficult task of selling goods overseas, he was sorry that British manufacturers as a whole were not more frank and prompt in giving information.

Mr. Boyd, supplementing the reply, said the time for secrecy had long passed, British makers had to complete with keen foreign competition, and abroad manufacturers had no hesitation in freely exchanging ideas and information.

Foundry-Plant Developments.

Because of the heterogeneity in the make-up of the foundry trade, its importance in relation to general industry is often lost sight of, and it is only when some spectacular order is placed that it is brought into its true perspective. One foundry, for instance, is just starting up a new plant, which means the passing of a payment of £23,000 to one foundry-equipment firm alone. The reconstruction of the new foundries for Ford, for Crane and for Austin will create an impressive amount of business for the equipment suppliers. Just recently we announced the value of the conveyor order for the Austin foundry. Announcements are now to hand that the sand blast is being supplied by Tilghman and the sand-preparing plant by August Muffle Furnaces, Limited, of Halifax. This will consist of four No. 2 size (6 ft. dia.) Simpson Patent intensive mixers. In this connection it is interesting to note that during the past year the aggregate capacity of Simpson mixers so far sold is 615 tons per hr., of which 295 tons is ascribable to repeat orders.

Trade Talk.

THE 4½ PER CENT. first mortgage debenture stock of Messrs. John Lysaght, Limited, will be redeemed on December 31, 1930, at 110 per cent.

THE STAFF and employees of the Ardrossan Dockyard Company have contributed the sum of £112 during the past six months to various charitable institutions.

MESSRS. A. & J. INGLIS, LIMITED, of Pointhouse, have received an order to build a composite vessel for the lightship service of the Corporation of Trinity House, London.

TENDERS FOR THE WORK of constructing the new bridge over the River Tees at Newport, Middlesbrough, are to be invited before the end of this month. It is anticipated that work will begin early in the New Year.

THE WAGES of the workmen in the Scottish manufactured iron trade will remain unchanged as a result of the auditors' examination of the employers' books for September and October. The average net selling price was £10 9s. 5.88d.

MESSRS. CROMPTON PARKINSON, LIMITED, have received what is believed to be the largest individual order for any one type of electrical motor. It is for 1,450 (Klosd) patent-type electrical motors, being the whole of the requirements for the new Ford plant at Dagenham.

MINING AND INDUSTRIAL EQUIPMENT, LIMITED, 11, Southampton Row, London, W.C.1, report that new orders have been received for the following equipment:—For England: A Raymond pulveriser and two Hum-mer electric screens; for France, two Raymond pulverisers; for Rhodesia, two Hum-mer electric screens.

MESSRS. RUSTON & HORNSBY, LIMITED, Lincoln, have secured an order for an additional six cylinder vertical oil engine for the Jerusalem Power Station. Three Ruston airless-injection engines of 450 b.h.p. were ordered for this undertaking at the beginning of 1929. The engine now ordered is required for the extension of the power station.

THE FOUNDRY DEPARTMENT and the ironworks department of the Shotts Iron Company, Limited, played a friendly challenge match on November 21. The programme consisted of carpet bowls, whist and billiards, and whilst the foundry workers excelled at the latter two games, the ironworkers won at bowls, so that the game ended in a draw of 14 points each.

THE GENERAL ELECTRIC COMPANY, LIMITED, are now producing a new range of direct-type contactor starters for starting 2- or 3-phase squirrel-cage motors by connecting them direct to line by the simple operation of a push button. These starters are available for motors of ½, 1, 2, 3, 5, 7½ and 10 h.p. up to 500 volts, each size being fitted with suitable no-volt and magnetic-overload time-lag releases.

MESSRS. JOHN LEWIS & SONS, LIMITED, Torry, Aberdeen, launched the trawler "Avonwater" last Thursday. This has been built for the North Line Steam Fishing Company, Limited, and is the first Aberdeen-built trawler to use superheated steam. The Mitchell thrust block will be installed, and in conjunction with a high boiler pressure the system of superheated steam will ensure more power and economy. The vessel will also have a bronze propeller. Triple-expansion engines fitted by the builders are also of special design and of greater power than that usually associated with this size and type of vessel.

THE GENERAL ELECTRIC COMPANY, LIMITED, have recently been awarded two orders, totalling £250,000 in value, for the electrical equipment of new rolling stock required by electric railways in this country. The first order covers some 300 heavy traction motors for the new rolling stock required by the London Underground Railways in connection with the Cockfosters-Hounslow extensions of their Piccadilly line, and the second is for the complete electrical equipment of 61 new coaches now being built to the order of the Metropolitan Railway for the augmentation of their suburban services. The equipment in both cases will be manufactured throughout at the General Electric Company's engineering works at Witton, Birmingham.

FURTHER ORDERS in connection with the new Dunston-on-Tyne "B" Power Station have been placed by the Newcastle Electric Supply Company, Limited. It is officially announced that the contract for boiler house and engine room steel-frame buildings has been awarded to Messrs. Dorman, Long & Company, Limited, Middlesbrough, the value of the contract being about £129,000. An order for two overhead electric travelling cranes (one capable of lifting 120 tons and the other 25 tons) has been given to Messrs. Joseph Booth & Bros., Limited, Leeds, the value of the contract being about £5,500. Complete circulating water pump-house equipment will be supplied by Messrs. Drysdale & Company, Limited, Glasgow, at a cost of about £12,000.

THE DARLINGTON RUSTLESS STEEL & IRON COMPANY, LIMITED, a new company formed recently for the production of rustless steel and iron manufactures, has its head offices at Alliance Works, Albert Hill, Darlington, which previously belonged to the Blake Boiler & Wagon Company, Limited. The company's products will largely be used in the production of motor-cars and in the manufacture of household appliances. The first work—after the reconditioning of works and installation of furnaces and equipment—will be to supply ingots to the strip, sheet and bar-rolling mills in the Midlands. Mr. John Lloyd Bentley has been appointed managing director of the company. Mr. Bentley has had extensive experience in this country and in America in this class of manufacture.

Personal.

MR. W. J. FLAVELL, a prominent member of the Birmingham Section of the Institute of British Foundrymen, has been made a Justice of the Peace for West Bromwich.

SIR HUGH BELL is entering upon his 28th year as chairman of the Tees Conservancy Commission, of which he has been a member for 50 years. Sir Hugh is nearly 87 years of age.

MR. J. J. MCCLELLAND, who for many years has represented Messrs. J. Evans & Company, Limited, of Manchester, in South Wales, has joined the staff of Messrs. Wm. Cumming & Company, Limited, of Glasgow, and elsewhere, as demonstrating representative for some recently-developed specialities.

MR. A. GARDNER, formerly manager of Messrs. Harland & Wolff's Clyde foundry, Govan, Glasgow, who for the past two years has been employed at Messrs. Smith & Wellstood, Limited, Bonnybridge, has taken up the management of Messrs. John Wallace & Sons, Limited, agricultural engineers, of Paton Street, Glasgow.

MR. A. BELL, works foreman for Messrs. Wilsons & Mathiesons, Limited, ironfounders, of Armley, Leeds, was last week the recipient of presentations from the directors and staff to mark his completion of 50 years' service. He entered the works as a lad in 1880, before the business of Charles Wilson & Sons became part of the concern of Wilsons & Mathiesons, Limited.

MR. A. K. WILSON, the ex-Master Cutler of Sheffield, who left this country on August 1 to undertake on behalf of Sheffield industries an investigation of market conditions and trade possibilities in South America, will arrive at Liverpool on December 19, in the liner "Orduna." Mr. Wilson was accompanied by Mr. C. R. Hodgson, President of the Sheffield Junior Chamber of Commerce. It is understood that investigations have been made into the market possibilities of Brazil, Uruguay, Argentina, Chile and Peru, and that much valuable information of interest to Sheffield industries has been obtained.

LT.-COL. T. S. MORRISEY, D.S.O., vice-president and general manager of the Combustion Engineering Corporation, Limited, Canada, an associate of International Combustion, Limited, has arrived in this country, and is staying at Fleming's Hotel, Clarges Street, Piccadilly, London, W.1. Col. Morrisey is severing his connection with Combustion Engineering Corporation, Limited, at the end of this year in order to join the board of United Engineers & Constructors (Canada), Limited, and during his visit to this country desires to meet executives of any British industries contemplating the establishment of factories or plants in Canadian territory.

Wills.

BIRCHALL, F. L., warehouse manager, of Messrs. Pegler Bros. & Company (Doncaster), Limited, brassfounders, of Belmont Works, Doncaster ... £6,142

Obituary.

WE REGRET to announce the death of Mr. A. Corbyn, M.I.Mech.E., works manager, Messrs. Richard Nevill & Company, Limited, of Llanelly. Mr. Corbyn was very prominent in the foundry industry of South Wales.

THE DEATH OCCURRED, last Saturday, after several weeks' illness, of Mr. Walter Grange, managing director of Messrs. Foster & Pullen, Limited, brass founders, of Fairweather Green, Bradford. Mr. Grange had been connected with the firm since its inception.

DR. RICHARD MOLDENKE, the well-known American foundryman and metallurgist, died at the age of 66 in the Muhlenberg Hospital, Plainfield, N.J., U.S.A., on November 17, following less than a month's illness. He was born in 1864 and graduated from the Columbia University School of Mines in 1885. Two years later he returned to receive his degree of doctor of philosophy. In 1889 he organised the electrical-engineering department at the Michigan School of Mines, and in the following year became metallurgist to Messrs. McConway & Farley Company, of Pittsburgh. He organised the Pennsylvania Malleable Company, of Pittsburgh, and, until production was well under way, acted as superintendent. For many years he conducted a complete experimental foundry on his estate at Watchung, in New Jersey. He acted as secretary of the American Foundrymen's Association from 1900 till 1904, and also was Vice-President of the American Society for Testing Materials. He was author of "Principles of Iron Founding" and of "The Production of Malleable Castings," as well as numerous Papers and articles on foundry subjects. The doctor and Mrs. Moldenke were regular visitors to Europe, and he was particularly prominent at the first International Conference held in Paris in 1922, whilst in 1928 he was the only delegate who crossed from America to attend the Spanish Foundry Conference.

MR. ALFRED HARVEY, manager of the Harvey-Siemens Furnaces branch of Messrs. Gibbons Bros., Limited, Dudley, died recently. Mr. Harvey was well known in the iron, steel and glass industries, having been engaged for many years in the construction and setting to work of regenerative gas furnaces for melting and reheating iron and steel and for melting glass. He gained practical experience with his brother, Mr. E. W. Harvey, from 1875-80 in puddling iron, reheating and rolling iron and steel at W. T. Henley's Telegraph Wire & Cable Works at North Woolwich, and later in melting steel there by the Siemens-Martin process. He was afterwards manager for two years of a Siemens steel-melting furnace for castings at Govan, Glasgow, and for several years was manager of the Siemens steel-melting plant for castings and the production of crucible steel at the works of John Spencer & Sons, Newburn, Newcastle-upon-Tyne. He was then appointed steelworks manager at the Cwm Avon Tinplate Works, South Wales, where he erected several steel-melting furnaces and a reversing rolling mill for bars. Subsequently he was one of the founders of the Albion Steelworks at Briton Ferry, where he superintended the erection of several steel-melting furnaces, Siemens gas reheating furnaces and rolling mills. In 1899 he joined the firm of Frederick Siemens as outside engineer to superintend the erection and the setting to work of the new and old types of Siemens furnaces. The Siemens furnace business was formed into a company in 1917, subsequently known as Harvey-Siemens Furnaces, Limited, Mr. Harvey being appointed one of the directors, and when in 1923, his brother, Mr. E. W. Harvey, retired, the late Mr. Alfred Harvey became a joint managing director with Mr. H. W. Jackson. Later on this company was taken over by Messrs. Gibbons Bros., Limited, of Dudley, and Mr. Alfred Harvey continued as principal manager of the Harvey-Siemens furnace business until his death, which occurred on November 12 at the age of 74.

MR. W. SHAW, President of the Middlesbrough Branch of the Institute of British Foundrymen, informs us that, in the course of his biography, which appeared in our issue of November 20, the capacity of the first open-hearth steel furnace built at the Wolsingham Works in 1862, was erroneously given as 15 tons. This, of course, should have been 15 cwts.

Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—As is not unusual at this period of the year, business in the Cleveland iron market has fallen to small proportions, and is now almost entirely confined to dealings to meet the immediate needs of consumers. Opinion in market circles inclines to the anticipation that the New Year may disclose some clearer idea of the trend of industrial progress and a brighter outlook for trade in general, and also bring some revision of the prices for pig-iron now current in the Tees-side market. To add to the already formidable difficulties of the Cleveland iron trade, makers are now confronted with a price-cutting competition by Continental producers. Foreign foundry iron has been offered here at a delivered price of about 9s. per ton below the fixed figure for No. 3 Cleveland G.M.B., and to consumers anxious to economise that is a temptation difficult to resist. It is improbable, therefore, that there will be any decline in the imports of foreign iron, whilst small quantities are also arriving here by rail from the Midlands. Thus assailed on two sides, Cleveland ironmasters still maintain a resolute front. On the subject of prices they are immovable on the following basis :—No. 1 Cleveland foundry iron, 66s. per ton; No. 3 G.M.B., 63s. 6d.; No. 4 foundry, 62s. 6d.; No. 4 forge, 62s. per ton.

In the market for East Coast hematite makers have been doing a fairly satisfactory volume of business with foreign buyers of late, but a further decline in Continental prices has had the effect of imposing a check on the local export trade. As regards quotations, for small lots of East Coast mixed numbers the price is still 71s. per ton, and for No. 1 quality a premium of 6d. per ton is asked. On the North-West Coast, Bessemer mixed numbers are quoted at 70s. per ton, at works.

LANCASHIRE.—In this area, at least, it is satisfying to see some signs of revival in the demand for foundry pig, current reports suggesting that the textile machinery founders are at present doing a rather better business than has been the case for some time past. Another hopeful sign is that most buyers at present appear to have more confidence in pig-iron prices than for a long time. Staffordshire and Derbyshire brands are on offer at 69s. 6d. per ton, with Northamptonshire iron at 68s., and Scottish makes, 91s. per ton, delivered equal to Manchester.

THE MIDLANDS.—As suggested in a previous report, the recent reduction of prices has had the effect of somewhat increasing the demand in the Black Country district. In this connection it has to be remembered that many consumers had been holding back for some time in the anticipation of lower levels obtaining, and stocks in many cases were practically non-existent. Even now contracting forward for any appreciable tonnages is quite exceptional, most of the ironfounders being content to order supplies sufficient to cover their requirements for a week or so ahead. The present zone prices are 67s. 6d. for Northants No. 3 and 71s. for North Staffordshire and Derbyshire No. 3, delivered to local stations.

SCOTLAND.—No improvement can yet be reported in the condition of the Scotch pig-iron market as concerns the home product, with the price still remaining on the basis of 76s. 6d. for No. 3 foundry f.o.t. furnaces. Consumers have been looking for a reduction in this figure, but with the fuel position as it is a fall in the meantime seems unlikely.

Finished Iron.

Markets for this class of material continue inactive, and unfortunately there is at present no prospect of a better state of affairs existing in the near future. Crown iron bars are offered at from £9 15s. to £10 5s., according to specification. Orders coming through for this grade of iron lack tonnage, and are of a very miscellaneous nature. The figure for Staffordshire marked bars remains at £12 10s., and the makers of this grade of iron are moderately well occupied. With regard to nut and bolt iron, although the prices from foreign works have recently advanced, their figures are still very much below those of local makers. The latter quote £8 15s. to £9, but get little or no support except for odd lots for immediate delivery, as the Continental product can be obtained at prices between £5 7s. 6d. and £5 10s. delivered.

Steel.

At Sheffield no change is reported in the steel market, and buying is on a small scale. Both acid and basic billets are in poor demand, with no prospect of early improvement. Wire rods attract little attention. No price alterations are recorded. There is stagnation in the open-hearth steel department. Steel for the motor-car industry makes a good showing, and manufacturers of the more expensive steels are booking good orders. Home and overseas railway business continues to shrink. In the tinplate market prices are inclined to lower levels, the current quotations for coke quality ruling at 16s. to 16s. 3d., net cash, f.o.b. Welsh ports.

Scrap.

Market operations in all classes of foundry scrap material are still on a limited scale, and on Tees-side this week consumers would only consider small parcels for prompt delivery. Prices are barely maintained, heavy cast iron being down to 50s., while machinery quality is offered in handy sizes at 53s. 6d., and light cast is on offer at 40s. In Yorkshire, heavy cast-iron scrap is in poor request, and the price for ordinary metal has eased to 50s. delivered. Machinery quality remains at 53s. 6d. delivered. In Scotland, very few of the foundries are purchasing or even interested in first-class machinery cast iron, but sellers are unwilling to dispose of any of this material at much below 60s. Ordinary cast iron is at 52s. 6d. to 53s. 9d., light metal 42s. 6d., furnace firebars are quoted at 41s. 3d., and cast-iron railway chairs at 57s. 6d. for forward delivery. The above prices are all per ton delivered f.o.t. consumers' works.

Metals.

Copper.—An outstanding feature in the market for warrant copper this week was the continued upward trend of values, which advanced practically to over £50 per ton. This movement reflects the comparative scarcity of electrolytic on this side, apart from what is offered by the sales agents of the Incorporated Exporters, for, in spite of the fact that customs smelters were quoting 10.50 cents, which is equal to about £50 c.i.f. European ports, copper was not available for export below about 11 cents per pound.

Closing quotations :—

Cash.—Thursday, £47 10s. to £47 12s. 6d.; Friday, £47 to £47 1s. 3d.; Monday, £48 17s. 6d. to £48 18s. 9d.; Tuesday, £50 7s. 6d. to £50 10s.; Wednesday, £49 5s. to £49 6s. 3d.

Three Months. — Thursday, £47 12s. 6d. to £47 15s.; Friday, £47 to £47 1s. 3d.; Monday, £48 17s. 6d. to £48 18s. 9d.; Tuesday, £50 7s. 6d. to £50 10s.; Wednesday, £40 5s. to £49 6s. 3d.

Tin.—Recording a decline of £2 per ton at the close of last week's market, the tone throughout has been dull and listless. Consumers have shown only an indifferent interest, and are evidently inclined to wait for a lower quotation. Stocks at Liverpool have been drawn upon to some extent, but, on the other hand, there is no evidence of any progress being made towards real unity in output curtailment.

Official closing prices :—

Cash.—Thursday, £114 to £114 2s. 6d.; Friday, £114 17s. 6d. to £115; Monday, £114 17s. 6d. to £115; Tuesday, £114 5s. to £114 7s. 6d.; Wednesday, £114 2s. 6d. to £114 5s.

Three Months.—Thursday, £115 7s. 6d. to £115 10s.; Friday, £116 to £116 5s.; Monday, £116 2s. 6d. to £116 5s.; Tuesday, £115 10s. to £115 12s. 6d.; Wednesday, £115 7s. 6d. to £115 10s.

Spelter.—This has been a weak market, with very little business moving in any direction. Reports as to the formation of the Zinc Cartel continue to be conflicting and much uncertainty prevails. Some demand for high-grade metal has been met, but the tonnage disposed of is not very considerable.

Daily fluctuations :—

Ordinary. — Thursday, £14 6s. 3d.; Friday, £14 6s. 3d.; Monday, £14 6s. 3d.; Tuesday, £14 8s. 9d.; Wednesday, £14 3s. 9d.

Lead.—The quotation has kept very close to £16, and there is little change to report just now in the general situation. Buyers are only mildly interested.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £16; Friday, £16 3s. 9d.; Monday, £15 17s. 6d.; Tuesday, £15 17s. 6d.; Wednesday, £15 15s.

Publication Received.

Anuario del Comercio Anglo-Sud Americano (British South American Trade Annual). Published by the South American Trade Annual, Limited, 74, Queen Victoria Street, London, S.W.1.

In view of the present interest in South American trade, because of the forthcoming British Exhibition in Buenos Aires, this publication, which is carried through entirely in Spanish, is particularly welcome. H.R.H. the Prince of Wales has contributed a foreword, and amongst those prominent in the foundry industry who have taken responsibility for various sections are Sir Hugo Hirst, Sir Robert Hadfield, Sir William Morris, Sir Gilbert Vyle and Sir William Larke.

Messrs Christmas & Walters, Limited, 8, Grosvenor Gardens, London, S.W.1, inform us that Messrs. Vickers-Armstrongs, Limited, of Barrow-in-Furness, have decided to instal an R. D. Wood gas machine and plant, which is about to be erected. This order also includes a "Chowning" gas-pressure regulator.

CAST IRON FLANGED PIPES
2 in.–12 in. & CONNECTIONS. to 24 in. dia.
WE HAVE FIFTY YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.
JAMES & RONALD RITCHIE, LTD.,
Telephone : 52 & 53. MIDDLESBROUGH. Telegrams : "Ritchie, Middlesbrough."

Special CARBON BLACKING

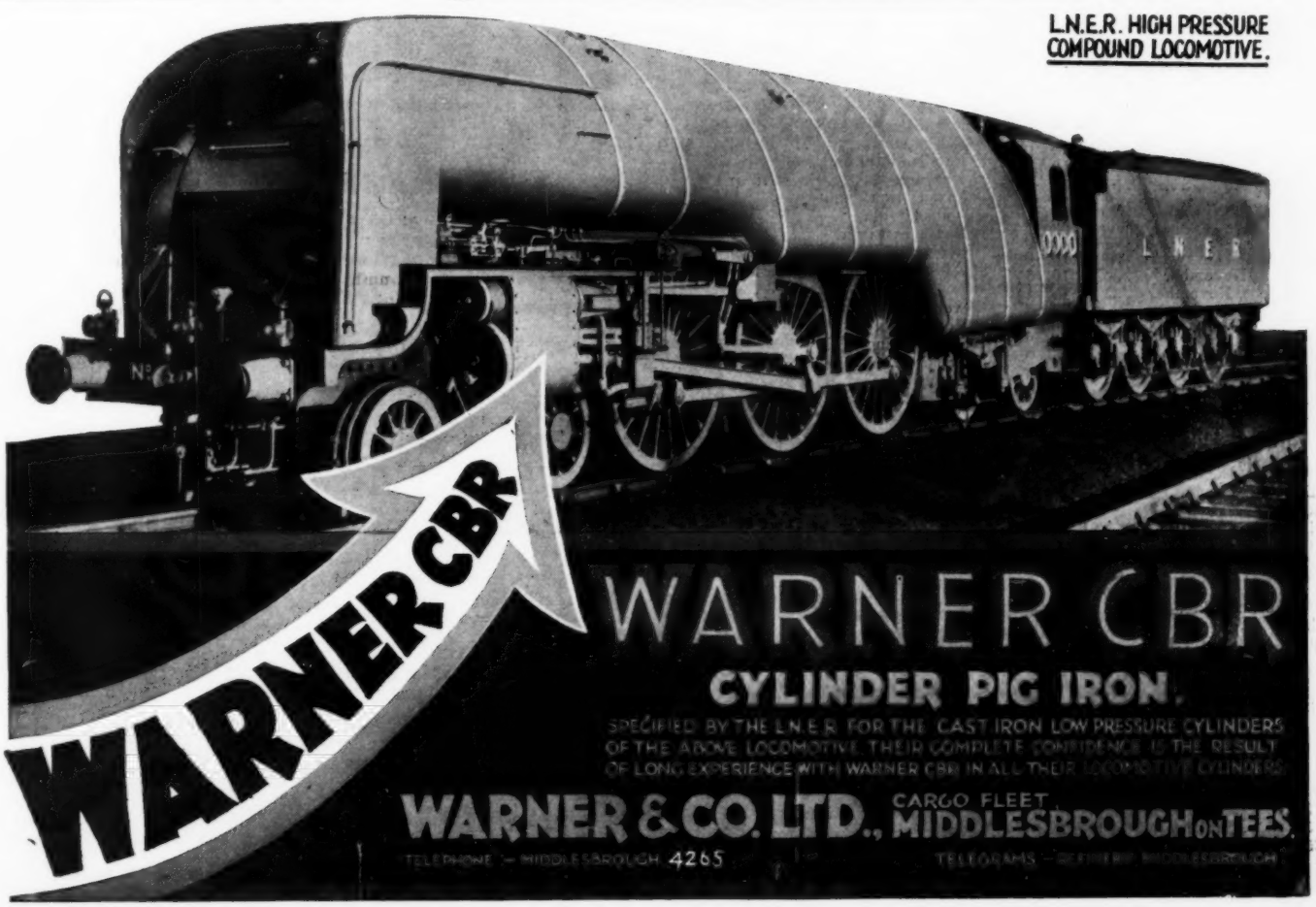
PLUMBAGO
CORE GUM
WHITE DUST
COAL DUST
REQUISITES

67 MADE BY A FIRM WITH YEARS EXPERIENCE.

JAS. DURRANS & SONS, LIMITED.
PHŒNIX WORKS, PENISTONE, NR. SHEFFIELD.

Also—
GANISTER.
LOAM AND SAND MILLS.
STUDS,
CHAPLETS,
BRUSHES,
CORE ROPES,
BUCKETS,
SPADES, Etc.
LADLES,
FIRE BRICKS,
STONE FLUX,
CASTING CLEANERS,
PIPE NAILS,
SPRIGS,
WIRE BRUSHES,
BELLOWS.

L.N.E.R. HIGH PRESSURE COMPOUND LOCOMOTIVE.



WARNER CBR

WARNER CBR
CYLINDER PIG IRON.
SPECIFIED BY THE L.N.E.R. FOR THE CAST IRON LOW PRESSURE CYLINDERS OF THE ABOVE LOCOMOTIVE. THEIR COMPLETE CONFIDENCE IS THE RESULT OF LONG EXPERIENCE WITH WARNER CBR IN ALL THEIR LOCOMOTIVE CYLINDERS.

WARNER & CO. LTD., CARGO FLEET, MIDDLESBROUGH ON TEES.
TELEPHONE — MIDDLESBROUGH 4265 TELEGRAMS — [illegible]

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	49	5	0
Three months	49	5	0
Electrolytic	55	0	0
Tough	51	10	0
Best selected	52	0	0
Sheets	84	0	0
India	66	10	0
Wire bars	56	15	0
Do. February	56	15	0
Do. March	56	15	0
Ingot bars	56	15	0
H.C. wire rods	57	10	0
Off. av. cash, November	46	3	8¼
Do., 3 mths. November	46	3	10½
Do., Sttlmnt., November	46	3	1½
Do., Electro, November	49	10	3
Do., B.S., November	48	1	10½
Do., wire bars, November	50	1	3
Solid drawn tubes			12d.
Brazed tubes			12d.
Wire			8d.

BRASS.

Solid drawn tubes	10½d.
Brazed tubes	11½d.
Rods, drawn	10d.
Rods, extd. or rlld.	6d.
Sheets to 10 w.g.	9d.
Wire	9d.
Rolled metal	8½d.
Yellow metal rods	6d.
Do. 4 × 4 Squares	6½d.
Do. 4 × 3 Sheets	6¾d.

TIN.

	£	s.	d.
Standard cash	114	2	6
Three months	115	7	6
English	115	15	0
Bars	117	5	0
Straits	118	7	6
Australian	117	12	6
Eastern	119	12	6
Banca	118	12	6
Off. av. cash, November	113	11	10½
Do., 3 mths., November	114	18	3¾
Do., Sttlmt., November	113	11	3

SPELTER.

	£	s.	d.
Ordinary	14	3	9
Remelted	12	15	0
Hard	11	10	0
Electro 99.9	16	15	0
English	14	17	6
India	12	10	0
Zinc dust	20	10	0
Zinc ashes	3	10	0
Off. aver., November	14	19	5½
Aver., spot, November	14	14	1½

LEAD.

	£	s.	d.
Soft foreign ppt.	15	15	0
English	17	5	0
Off. average, November	15	18	7½
Average spot, November	15	18	8½

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	0	0
Do. V.M. ex-whf.	24	10	0
Rods	28	0	0
Boiler plates	21	0	0
Battery plates	21	0	0

ANTIMONY.

	£	s.	d.
Special brand, Eng.	36	0	0
Chinese	25	5	0
Crude	22	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	22	10	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d.
Ferro-silicon—			
25%	7	15	0
45/50%	11	7	6
75%	18	12	6
Ferro-vanadium—			
35/50%	12/8 lb. Va.		
Ferro-molybdenum—			
70/75% c. free	4/2 lb. Mo.		
Ferro-titanium—			
23/25% carbon-free	11½d. lb.		
Ferro-phosphorus, 20/25%	£15	17	6
Ferro-tungsten—			
80/85%	2/3 lb.		
Tungsten metal powder—			
98/99%	2/6 lb.		
Ferro-chrome—			
2/4% car.	£30	5	0
4/6% car.	£23	0	0
6/8% car.	£22	2	6
8/10% car.	£21	17	6
Ferro-chrome—			
Max. 2% car.	£32	17	6
Max. 1% car.	£37	12	6
Max. 0.70% car.	£40	17	6
70% carbon-free	10d. lb.		
Nickel—99% cubes, or pellets	£175	0	0
Ferro-cobalt	9/7 lb.		
Aluminium 98/99%	£85	0	0
Metallic chromium—			
96/98%	2/7 lb.		
Ferro-manganese (net)—			
76/80% loose	£11 0 0 to £11 10 0		
76/80% packed	£12 0 0 to £12 15 0		
76/80% export	£10 10 0 to £11 0 0		
Metallic manganese—			
94/96% carbonless	1/4 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0	2	2
Finished bars, 18% tungsten	£0	3	0

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to $\frac{3}{16}$ in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ¼ in.	3d. lb.
Do., under ¼ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel					2	5	0
Bundled steel and shrngs.	1	15	0	to	1	18	0
Mixed iron and steel	1	15	0	to	2	0	0
Heavy cast iron					2	5	0
Good machinery for foundries	2	7	6	to	2	10	0
Cleveland—							
Heavy steel					2	6	0
Steel turnings					1	15	0
Cast-iron borings					1	10	0
Heavy forge					3	2	6
W.I. piling scrap					2	17	6
Cast-iron scrap	2	10	0	to	2	13	6
Midlands—							
Ord. cast-iron scrap					2	5	0
Heavy wrought					2	15	0
Steel turnings					1	0	0
Scotland—							
Heavy steel					2	10	0
Ordinary cast iron					2	12	6
Engineers' turnings					1	13	9
Cast-iron borings					1	10	0
Wrought-iron piling					3	0	0
Heavy machinery					3	0	0

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	40	0	0
Brass	30	0	0
Lead (less usual draft)	14	0	0
Tea lead	10	10	0
Zinc	8	10	0
New aluminium cuttings	50	0	0
Braziery copper	37	0	0
Gunmetal	39	0	0
Hollow pewter	80	0	0
Shaped black pewter	60	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	66/-
Foundry No. 3	63/6
Foundry No. 4	62/6
Forge No. 4	62/-
Hematite No. 1	71/-
Hematite M/Nos.	70/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	78/6
„ d/d Birm.	88/6
Midlands—	
Staffs. common*	—
„ No. 4 forge*	66/-
„ No. 3 fdry.*	71/-
Shrops. basic	—
„ Cold blast, ord.	—
„ „ roll iron	—
Northants forge*	62/6
„ fdry. No. 3*	67/6
Derbyshire forge*	66/-
„ fdry. No. 3*	71/-
„ basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	79/-
„ No. 3	76/6
Hem. M/Nos.	77/-
Sheffield (d/d district)—	
Derby forge	61/-
„ fdry. No. 3	66/-
Lincs. forge	—
„ fdry. No. 3	66/-
E.C. hematite	83/6
W.C. hematite	86/6
Lincs. (at furnaces)—	
Forge No. 4	—
Foundry No. 3	—
Basic	—
Lancashire (d/d eq. Man.)—	
Derby forge	64/6
„ fdry. No. 3	69/6
Staffs foundry No. 3	69/6
Dalzell, No. 3 (special)	105/- to 107/6
Summerlee, No. 3	91/-
Glengarnock, No. 3	—
Eglinton, No. 3	91/-
Gartsherrie, No. 3	91/-
Monkland, No. 3	91/-
Shotts, No. 3	91/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£	s.	d.		£	s.	d.
Iron—							
Bars (cr.)	10	0	0	to	10	15	0
Nut and bolt iron	8	15	0	to	9	0	0
Hoops	10	15	0	to	12	0	0
Marked bars (Staffs) f.o.t.					12	10	0
Gas strip	10	15	0	to	12	0	0
Bolts and nuts, ¾ in. × 4 in.					15	5	0
Steel—							
Ship plates	8	15	0	to	8	17	6
Boiler plts.	9	7	6	to	10	5	0
Chequer plts.					10	12	6
Angles					8	7	6
Tees					9	7	6
Joists					8	10	0
Rounds and squares, 3 in. to 5½ in.					9	7	6
Rounds under 3 in. to ¾ in. (Untested)					7	12	6

and upwards

Flats—8 in. wide and over	8	12	6
„ under 8 in. and over 5in.	8	17	6
Rails, heavy	8	10	0
Fishplates	12	0	0
Hoops (Staffs)	9	5	0 to 9 10 0
Black sheets, 24g.	8	12	6 to 9 12 6
Galv.cor.shts., 24g.	11	5	0
Galv fencing wire, 8g. plain	12	0	0
Billets, soft	5	12	6 to 6 5 0
Billets, hard	7	10	0 & up.
Sheet bars	5	0	0 to 5 12 6
Tin bars	5	0	0 to 5 12 6

PHOSPHOR BRONZE.

	Per lb. bas.
Strip	1/-
Sheet to 10 w.g.	1/1½
Wire	1/2
Rods	1/1½
Tubes	1/6
Castings	1/1

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	8d. to 1/2
Rolled—	
To 9 in. wide	1/2 to 1/8
To 12 in. wide	1/2½ to 1/8½
To 15 in. wide	1/2½ to 1/8½
To 18 in. wide	1/3 to 1/9
To 21 in. wide	1/3½ to 1/9½
To 25 in. wide	1/4 to 1/10
Ingots for spoons and forks	8d. to 1/4½
Ingots rolled to spoon size	11d. to 1/7½
Wire round—	
3/0 to 10 G.	1/5½ to 2/0½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	18.76
No. 2 foundry, Valley	17.00
No. 2 foundry, Birm.	14.00
Basic	18.76
Bessemer	19.26
Malleable	19.26
Grey forge	18.76
Ferro-mang. 80%	94.00
O.-h. rails, h'y, at mill	43.00
Billets	31.00
Sheet bars	31.00
Wire rods	36.00
	Cents.
Iron bars, Phila.	2.09
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Skelp, sheared steel	1.70
Steel hoops	1.95
Sheets, black, No. 24	2.45
Sheets, galv., No. 24	2.95
Sheets, blue an'l'd, No. 13	2.05
Wire nails	1.95
Plain wire	2.30
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$5.00

COKE (at ovens).

Welsh foundry	25/- to 27 6
„ furnace	16/- to 18/-
Durham and Northumberland—	
„ foundry	14/6 to 15/-
„ furnace	14/6
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 box		16/-
„	28×20 „		32/-
„	20×10 „		23/3
„	18¾×14 „		17/-
C.W.	20×14 „		15/-
„	28×20 „		30/6
„	20×10 „		21/6
„	18¾×14 „		16/9
Terneplates	28×20		31/- per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0	to	£7	10	0
Bars, hammered, basis	£17	10	0	to	£18	10	0
Bars and nail-rods, rolled, basis	£15	17	6	to	£16	15	0
Blooms	£10	0	0	to	£12	0	0
Keg steel	£32	0	0	to	£33	0	0
Faggot steel	£20	0	0	to	£24	0	0
Bars and rods dead soft, steel	£11	0	0	to	£14	0	0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.

Over ⅛ in. up to 6 in.

	Tubes.	*Fittings.*
Gas	62½%	47½%
Water ..	58½%	42½%
Steam ..	55%	37½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

			£	s.	d.	
Nov.	27	..	47	10	0	No change
..	28	..	47	0	0	dec. 10/-
Dec.	1	..	48	17	6	inc. 37/6
..	2	..	50	7	6	.. 30/-
..	3	..	49	5	0	dec. 22/6

Electrolytic Copper.

			£	s.	d.	
Nov.	27	..	51	0	0	No change
..	28	..	51	0	0	.. ..
Dec.	1	..	51	10	0	inc. 10/-
..	2	..	55	0	0	.. 70/-
..	3	..	55	0	0	No change

Standard Tin (cash).

			£	s.	d.	
Nov.	27	..	114	0	0	dec. 2/6
..	28	..	114	17	6	inc. 17/6
Dec.	1	..	114	17	6	No change
..	2	..	114	5	0	dec. 12/6
..	3	..	114	2	6	.. 2/6

Tin (English ingots).

			£	s.	d.	
Nov.	27	..	115	0	0	dec. 5/-
..	28	..	116	0	0	inc. 20/-
Dec.	1	..	116	0	0	No change
..	2	..	115	5	0	dec. 15/-
..	3	..	115	15	0	inc. 10/-

Zinc Sheets (English).

			£	s.	d.	
Nov.	27	..	24	0	0	No change
..	28	..	24	0	0	.. ..
Dec.	1	..	24	0	0	.. ..
..	2	..	24	0	0	.. ..
..	3	..	24	0	0	.. ..

Spelter (ordinary).

			£	s.	d.	
Nov.	27	..	14	6	3	inc. 2/6
..	28	..	14	6	3	No change
Dec.	1	..	14	6	3	.. ..
..	2	..	14	8	9	inc. 2/6
..	3	..	14	3	9	dec. 5/-

Lead (English).

			£	s.	d.	
Nov.	27	..	17	10	0	No change
..	28	..	17	10	0	.. ..
Dec.	1	..	17	5	0	dec. 5/-
..	2	..	17	5	0	No change
..	3	..	17	5	0	.. ..

AVERAGE MONTHLY PRICES OF STEEL BOILER PLATES IN ENGLAND.

Year.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1895	5 15 0	5 15 0	5 12 6	5 12 6	5 15 0	5 17 6	5 15 0	5 17 6	6 0 0	6 0 0	6 2 6	6 0 0	5 16 10½
1896	6 0 0	6 0 0	6 2 6	6 2 6	6 2 6	6 0 0	6 0 0	6 0 0	6 0 0	6 2 6	6 10 0	6 10 0	6 2 6
1897	6 10 0	6 10 0	6 10 0	6 7 6	6 2 6	6 2 6	6 5 0	6 0 0	6 0 0	6 0 0	6 7 6	6 10 0	6 5 5
1898	6 10 0	6 8 9	6 8 9	6 10 0	6 15 0	6 18 9	6 17 6	6 17 6	7 2 6	6 15 0	7 0 0	7 5 0	6 15 8½
1899	7 5 0	8 0 0	8 2 6	8 2 6	8 5 0	8 5 0	8 12 6	8 12 6	8 15 0	8 15 0	9 2 6	9 5 0	8 17 8½
1900	9 5 0	9 5 0	9 7 6	9 10 0	9 12 6	10 5 0	10 5 0	10 5 0	10 5 0	10 0 0	9 15 0	9 15 0	9 15 10
1901	9 5 0	9 5 0	8 15 0	8 10 0	8 10 0	7 10 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	8 3 11
1902	7 7 6	7 0 0	7 12 6	7 12 6	7 12 6	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 9 7
1903	7 10 0	7 10 0	7 15 0	7 5 0	7 5 0	7 5 0	7 5 0	7 0 0	7 0 0	7 0 0	7 0 0	6 17 6	7 3 11½
1904	6 12 6	6 15 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	6 18 11½
1905	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 10 0	7 5 0	8 0 0	8 0 0	7 1 3
1906	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 10 0	8 0 10
1907	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 0 0	8 0 0	8 8 4
1908	7 10 0	7 10 0	7 10 0	7 5 0	7 5 0	7 5 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 3 9
1909	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	6 15 0	6 15 0	6 15 0	7 0 0	7 0 0	7 0 0	7 0 0	6 18 9
1910	7 0 0	7 0 0	7 1 3	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 10 0	7 10 0	7 10 0	7 5 1
1911	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 14 0	7 10 4
1912	7 18 9	8 0 0	8 0 0	8 7 6	8 10 0	8 10 0	8 10 0	8 15 0	8 16 3	9 0 0	9 2 0	9 5 0	8 11 2½
1913	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	8 19 0	8 15 0	8 5 0	7 15 0	7 15 0	8 17 0
1914	7 15 0	7 15 0	7 15 0	7 13 9	7 10 6	7 5 0	7 0 0	8 0 0	8 2 6	8 5 0	8 5 0	8 5 0	7 15 11½
1915	8 14 0	9 10 0	9 17 6	10 10 0	10 10 0	11 0 0	11 0 0	11 0 0	11 0 0	11 4 0	12 0 0	13 0 0	10 15 5½
1916	13 0 0	13 0 0	13 0 0	12 15 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 12 11
1917	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1918	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1919	13 0 0	15 0 0	15 0 0	15 0 0	19 5 0	19 17 6	21 0 0	21 10 0	21 10 0	21 15 0	21 10 0	23 10 0	18 9 9
1920	28 0 0	28 0 0	28 5 0	28 10 0	29 5 0	30 0 0	30 0 0	30 0 0	30 10 0	31 0 0	31 0 0	31 0 0	29 9 2
1921	30 5 0	29 0 0	25 0 0	25 0 0	25 0 0	23 0 0	21 0 0	20 10 0	19 0 0	17 10 0	16 0 0	14 16 0	22 1 9
1922	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	13 1 8	13 10 0	12 15 0	12 10 0	12 10 0	12 10 0	12 6 0	13 10 9
1923	12 8 9	13 6 0	14 0 0	14 0 0	14 0 0	14 0 0	13 12 6	13 0 0	13 0 0	13 0 0	13 0 0	13 10 0	13 9 1½
1924	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	14 0 0	14 0 0	13 11 0	13 5 0	13 5 0	13 10 11
1925	13 5 0	13 5 0	13 5 0	13 1 0	12 15 0	12 15 0	12 15 0	12 15 0	12 7 6	11 14 0	11 10 0	11 10 0	12 11 5½
1926	11 10 0	11 10 0	11 10 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 6 3
1927	11 5 0	11 5 0	11 5 0	11 5 0	11 2 6	11 0 0	11 0 0	11 0 0	10 16 0	10 10 0	10 10 0	10 10 0	10 19 0½
1928	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0
1929	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 5 0	10 1 3	10 1 3	10 1 3	10 1 7	10 6 8½
1930	10 2 9	10 3 5½	10 3 9	10 3 9	10 3 6	10 2 6	10 2 6	10 2 6	10 2 2½	9 19 6	9 16 3	—	—

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